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BASELINE ECOLOGICAL RISK ASSESSMENT WORK PLAN & SAMPLING AND ANALYSIS PLAN

FOR THE
GULFCO MARINE MAINTENANCE
SUPERFUND SITE
FREEPORT, TEXAS

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TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ACRONYMS

AET – apparent effects threshold

$AF_{soil/sediment}$ – chemical bioavailability factor from soil/sediment (unitless)

AST – aboveground storage tank

AUF – area-use factor (unitless)

AVS/SEM – Acid Volatile Sulfide/Simultaneously Extracted Metals

BAF – bioaccumulation factor

BERA – Baseline Ecological Risk Assessment

BSAF – biota-sediment accumulation factor

BW – wildlife receptor body weight (kg)

C_{food} – chemical concentration in food (mg/kg)

$C_{soil/sediment}$ – chemical concentration in soil/sediment (mg/kg)

COI – chemicals of interest

COPEC – contaminants of potential ecological concern

CSM – conceptual site model

DDD – dichlorodiphenyldichloroethylene

DDE – dichlorodiphenyldichloroethane

DDT – dichlorodiphenyltrichloroethane

DQO – Data Quality Objective

EPA – United States Environmental Protection Agency

EPC – exposure point concentration

ERA – Ecological Risk Assessment

ERL – effects range low

ERM – effects range medium

HPAH – high-molecular weight polynuclear aromatic hydrocarbon

HQ – hazard quotient

IR_{food} – food ingestion rate (kg/day)

$IR_{soil/sediment}$ – soil/sediment ingestion rate (kg/day)

LOAEL – lowest observable effects level

LPAH – low-molecular weight polynuclear aromatic hydrocarbon

NEDR – Nature and Extent Data Report

NOAEL – no observable adverse effects level

NPL – National Priorities List

PAH – polynuclear aromatic hydrocarbon

PCB – polychlorinated biphenyl

PCL – Protective Concentration Level

PSA – Potential Source Area

QAPP – Quality Assurance Project Plan

RI/FS – Remedial investigation/Feasibility Study

RME – reasonable maximum exposure

ROPC – receptors of potential concern

SEL – Second Effects Level

SLERA – Screening-Level Ecological Risk Assessment

SMDP – Scientific Management Decision Point

SOW – Statement of Work

TCEQ – Texas Commission on Environmental Quality

TDSHS – Texas Department of State Health Services

TPWD – Texas Parks and Wildlife Department

TRV – species-specific toxicity reference value

TSWQS – Texas Surface Water Quality Standard

UAO – Unilateral Administrative Order

UCL – upper confidence limit

USDA – United States Department of Agriculture

USFWS – United States Fish and Wildlife Service

1.0 INTRODUCTION

The United States Environmental Protection Agency (EPA) named the former site of Gulfco Marine Maintenance, Inc. in Freeport, Brazoria County, Texas (the Site) to the National Priorities List (NPL) in May 2003. The EPA issued a modified Unilateral Administrative Order (UAO), effective July 29, 2005, which was subsequently amended effective January 31, 2008. The UAO required Respondents to conduct a Remedial Investigation and Feasibility Study (RI/FS) for the Site. Pursuant to Paragraph 37(d)(x) of the Statement of Work (SOW) for the RI/FS, included as an Attachment to the UAO, a Final Screening Level Ecological Risk Assessment (SLERA) was prepared for the Site (PBW, 2010). The Scientific/Management Decision Point (SMDP) provided in the Final SLERA concluded that the information presented therein indicated a potential for adverse ecological effects, and a more thorough assessment was warranted. This Baseline Ecological Risk Assessment (BERA) Work Plan has been prepared, consistent with Paragraphs 37(d)(xi) and (xii) of the UAO as the next step in that assessment. This report was prepared by Pastor, Behling & Wheeler, LLC (PBW), on behalf of LDL Coastal Limited LP (LDL), Chromalloy American Corporation (Chromalloy) and The Dow Chemical Company (Dow), collectively known as the Gulfco Restoration Group (GRG).

1.1 REPORT PURPOSE

Following completion of the SLERA, the BERA Problem Formulation was conducted to identify the specific ecological issues at the Site and determine the scope and goals of the BERA in accordance with Paragraph 37(d)(xi) (Step 3) of the SOW for the RI/FS. The BERA Problem Formulation further refined or identified contaminants of ecological concern, ecological effects of contaminants, fate and transport, assessment endpoints, and the Conceptual Site Model (CSM). The CSM was used to develop an investigation plan and establish the data requirements and data quality objectives to be achieved through the BERA. This Work Plan has been prepared to describe the CSM and the investigation components necessary to complete the BERA. The Work Plan includes a Sampling and Analysis Plan (SAP) that establishes the specific sampling locations, equipment, and procedures to be used during the BERA.

Per EPA direction, this Work Plan and SAP is being submitted concurrent with the Draft BERA Problem Formulation Report. As such, the investigation activities proposed herein may be subject to revision based on review comments and revisions to the Draft BERA Problem

Formulation Report. Also it should be noted that EPA and the GRG are in the process of finalizing an Administrative Settlement Agreement and Order on Consent for Removal Action (Removal Action AOC). This Removal Action is intended to: (1) address the aboveground storage tank farm (AST Tank Farm) in the South Area of the Site; and (2) facilitate repair of the existing cap on the former surface impoundments in the North Area of the Site. It is possible that some of the activities performed as part of this Removal Action (e.g., extension of the southern part of the former impoundments cap as part of the cap repair work) may obviate the need for some of the investigation activities proposed herein, and thus may result in modifications to this Work Plan and SAP. Similarly, should EPA and the GRG determine that other removal and/or response actions are to be performed at the Site, those activities may, depending on their timing and scope, preclude the need for some of the proposed investigation activities and may also result in modifications to this Work Plan and SAP.

The objective of this Work Plan and SAP is to document the decisions and evaluations made during the BERA Problem Formulation and to identify the additional investigation activities needed to complete the evaluation of ecological risks. This Work Plan and SAP presents the conclusions of the BERA Problem Formulation, and the methods and procedures necessary to complete the BERA based on those conclusions. This Work Plan and SAP includes the general scope of activities to be conducted during the BERA, and a detailed description of the sampling and data-gathering procedures.

1.2 SITE BACKGROUND

The Site is located in Freeport, Texas at 906 Marlin Avenue (also referred to as County Road 756) (Figure 1). The Site consists of approximately 40 acres along the north bank of the Intracoastal Waterway between Oyster Creek (approximately one mile to the east) and the Texas Highway 332 bridge (approximately one mile to the west). The Site includes approximately 1,200 feet (ft.) of shoreline on the Intracoastal Waterway, the third busiest shipping canal in the US (TxDOT, 2001) that, on the Texas Gulf Coast, extends 423 miles from Port Isabel to West Orange.

Marlin Avenue divides the Site into two primary areas (Figure 2). For the purpose of descriptions in this report, Marlin Avenue is approximated to run due west to east. The property to the north of Marlin Avenue (the North Area) consists of undeveloped land and closed surface

impoundments, while the property south of Marlin Avenue (the South Area) was developed for industrial uses with multiple structures, a dry dock, sand blasting areas, an aboveground storage tank (AST) tank farm, and two barge slips connected to the Intracoastal Waterway.

Adjacent property to the north, west, and east of the North Area is undeveloped. Adjacent property to the east of the South Area is currently used for industrial purposes while to the west the property is currently vacant and previously served as a commercial marina. The Intracoastal Waterway bounds the Site to the south. Residential areas are located south of Marlin Avenue, approximately 300 feet west of the Site, and 1,000 feet east of the Site.

The South Area includes approximately 20 acres of upland that was created from dredged material from the Intracoastal Waterway. The two most significant surface features within the South Area are a Former Dry Dock and the AST Tank Farm. The remainder of the South Area surface consists primarily of former concrete laydown areas, concrete slabs from former Site buildings, gravel roadways and sparsely vegetated open areas with some localized areas of denser brush vegetation, particularly near the southeast corner of the South Area.

Some of the North Area is upland created from dredge spoil, but most of this area is considered wetlands, as per the United States Fish and Wildlife Service (USFWS) Wetlands Inventory Map (USFWS, 2008). This wetland area generally extends from East Union Bayou to the southwest, to the Freeport Levee to the north, to Oyster Creek to the east (see Figure 1). The most significant surface features in the North Area are two ponds (the Fresh Water Pond and the Small Pond) and the closed former surface impoundments. The former surface impoundments and the former parking area south of the impoundments and Marlin Avenue comprise the vast majority of the upland area within the North Area.

Field observations during the RI indicate that the North Area wetlands are irregularly flooded with nearly all of the wetland area inundated by surface water that can accumulate to a depth of one foot or more during extreme high tide conditions, storm surge events, and/or in conjunction with surface flooding of Oyster Creek northeast of the Site. Due to a very low topographic slope and low permeability surface sediments, the wetlands are also very poorly draining and can retain surface water for prolonged periods after major rainfall events. Under normal tide conditions and during periods of normal or below normal rainfall, standing water within the wetlands (outside of

the two ponds discussed below) is typically limited to a small, irregularly shaped area immediately north of the Fresh Water Pond and a similar area immediately south of the former surface impoundments. Both of these areas can be completely dry, as was observed in June 2008. As such, given the absence of any appreciable areas of perennial standing water, the wetlands are effectively hydrologically isolated from Oyster Creek, except during intermittent, and typically brief, flooding events.

The Fresh Water Pond is approximately 4 to 4.5 feet deep and is relatively brackish (specific conductance of approximately 40,000 umhos/cm and salinity of approximately 25 parts per thousand). This pond appears to be a borrow pit created by the excavation of soil and sediment as suggested by the well-defined pond boundaries and relatively stable water levels. Water levels in the Fresh Water Pond are not influenced by periodic extreme tidal fluctuations as the pond dikes preclude tidal floodwaters in the wetlands from entering the pond, except for extreme storm surge events, such as observed during Hurricane Ike in September 2008.

The Small Pond is a very shallow depression located in the eastern corner of the North Area. The Small Pond is not influenced by daily tidal fluctuations and behaves in a manner consistent with the surrounding wetland, i.e., becomes dry during dry weather, but retains water in response to and following rainfall and extreme tidal events. Water in the Small Pond is less brackish based on specific conductance (approximately 14,000 umhos/cm) and salinity (approximately eight parts per thousand) measurements.

1.3 REPORT ORGANIZATION

This Work Plan and SAP has been organized in a manner consistent with the recommendation presented in the EPA guidance for conducting ecological risk assessments (EPA, 1997), which is based on the EPA guidance for risk assessments and the EPA guidance for conducting RI/FS studies under CERCLA. A discussion of the Site presented in Section 1. Section 2 presents the Work Plan, including the Conceptual Site Model (CSM), assessment endpoints, risk questions and testable hypotheses, and measurement endpoints. An overview of the ecological investigation design, including the data quality objectives established for the study, are presented in Section 3. The Field Sampling Plan (FSP), which details the sampling types and objectives, sampling location, timing, and frequency, sample designation, sampling equipment and

procedures, and sample handling, is presented in Section 4. The Quality Assurance Project Plan (QAPP) included as Section 5. Health and safety procedures are discussed in Section 6.

2.0 WORK PLAN

2.1 CONCEPTUAL SITE MODEL

Preliminary CSMs for the aquatic and terrestrial ecosystems were described in the SLERA. During problem formulation, these CSMs were updated to consider the results of the COPEC refinement, expanded review of potential ecological effects of those COPECs, and the more detailed fate and transport evaluation. Updated CSMs based on these considerations are shown on Figures 3 and 4. These CSMs are discussed below.

The identification of potentially complete exposure pathways is performed to evaluate the exposure potential as well as the risk of effects on ecosystem components. In order for an exposure pathway to be considered complete, it must meet all of the following four criteria (EPA, 1997):

- A source of the contaminant must be present or must have been present in the past.
- A mechanism for transport of the contaminant from the source must be present.
- A potential point of contact between the receptor and the contaminant must be available.
- A route of exposure from the contact point to the receptor must be present.

Exposure pathways can only be considered complete if all of these criteria are met. If one or more of the criteria are not met, there is no mechanism for exposure of the receptor to the contaminant. Potentially complete pathways are shown in the conceptual site models for the terrestrial and estuarine ecosystems (Figures 3 and 4, respectively).

In general, biota can be exposed to chemical stressors through direct exposure to abiotic media or through ingestion of forage or prey that have accumulated contaminants. Exposure routes are the mechanisms by which a chemical may enter a receptor's body. Possible exposure routes include 1) absorption across external body surfaces such as cell membranes, skin, integument, or cuticle from the air, soil, water, or sediment; and 2) ingestion of food and incidental ingestion of soil, sediment, or water along with food. Absorption is especially important for plants and aquatic life.

The terrestrial ecosystem CSM (Figure 3) begins with historical releases of the COPECs from the former surface impoundments and operations areas in the North and South Areas. Soil became

contaminated with the COPECs and contaminated soil was transported from its original location to other portions of the Site via the transport mechanisms of surface runoff and airborne suspension/deposition. The significant potential receptors (soil invertebrates) are then exposed to soils in their original location or otherwise via direct contact or ingestion of soil.

The aquatic ecosystem CSM (Figure 4) begins with historical releases of the COPECs from barge cleaning operations that impacted sediment in the barge slips of the Intracoastal Waterway and surface water and sediment in the North Area wetlands. These areas were impacted via the primary release mechanisms of direct discharge from past operations, surface runoff, and particulate dust/volatile emissions. Tidal flooding and rainfall events created secondary release mechanisms of resuspension/deposition, bioirrigation, and bioturbation, such that other areas of surface water and sediment became contaminated. The significant potential receptors (sediment and water-column invertebrates) are then exposed to the contaminated surface water and sediment in their original location or otherwise via direct contact or ingestion of surface water and sediment.

2.2 ASSESSMENT ENDPOINTS

Assessment endpoints are explicit expressions of the ecological resource to be protected for a given receptor of potential concern (EPA, 1997). Assessment endpoints were identified in the SLERA to focus the screening evaluation on relevant receptors rather than attempting to evaluate risks to all potentially affected ecological receptors. As part of the problem formulation, these assessment endpoints were further refined. The site-specific assessment endpoints are presented in Section 5 of the Problem Formulation and included in Table 1 of this Work Plan.

2.3 RISK QUESTIONS

Ecological risk questions are proposed regarding assessment endpoints and their response to COPECs. These questions are used to guide the study design, evaluate the study results, and perform the risk characterization (EPA, 1997). Risk questions are posed for the assessment endpoints established for the BERA, as presented in the BERA problem formulation, are presented in Table 1.

2.4 MEASUREMENT ENDPOINTS

The definition of measurement endpoints has evolved over time to include measures of ecosystem characteristics, life-history considerations, exposure, or other measures and is now more accurately termed "measures of effect" (EPA, 1998). The EPA has established three categories of measures:

(1) Measures of effect – Measureable changes in an attribute of an assessment endpoint or its surrogate in response to a stressor to which it is exposed (formerly measurement endpoints);

(2) Measures of Exposure – Measures of stressor existence and movement in the environment and their contact or co-occurrence with the assessment endpoint; and

(3) Measures of ecosystem and receptor characteristics – Measures of ecosystem characteristics that influence the behavior and location of entities selected as the assessment endpoint, the distribution of a stressor, and life-history characteristics of the assessment endpoint or its surrogate that may affect exposure or response to the stressor.

Measures of effect and measures of exposure will be used as the measurement endpoints to determine if adverse impacts are potentially occurring to the chosen assessment endpoints. The measure of exposure will be analytical measurements of the COPECs in sediment (bulk and pore water) and surface water samples. The measure of effect will be laboratory toxicity testing of Site samples of bulk sediment and surface water compared to laboratory control samples. Table 1 presents the guilds and their representative receptors, the BERA assessment endpoints, the ecological risk questions and testable hypotheses, and the measurement endpoints.

2.5 UNCERTAINTIES AND ASSUMPTIONS

Risk assessments are designed to evaluate uncertainty, which is used to develop an investigation program that will result in the greatest decrease in uncertainty. The principal uncertainties inherent in all risk assessments are identified by the EPA as variability, uncertainty of the true value (i.e., measurement error), and data gaps (EPA, 1998). Throughout the risk assessment process, iterative steps are taken to reduce the uncertainty of the assessment, primarily through the collection of additional data until sufficient evidence has been collected that the inherent

uncertainty is reduced to an acceptable level. The approach used in this risk assessment reduces uncertainty by focusing the investigation goals on the specific pathways and receptors identified in the Problem Formulation.

2.5.1 Uncertainties in the Conceptual Site Model

The conceptual model prepared for a site can be the source of significant uncertainty in a risk assessment due to a variety of factors, including lack of knowledge about ecosystem functions, a poor understanding of temporal and spatial parameter interaction, omission of stressors, or neglecting secondary effects (EPA, 1998). The uncertainties in the conceptual model prepared for the BERA have been reduced through the consideration of alternate models that account for a multitude of variables present at the Site.

2.5.2 Uncertainties in the Field Study

Sources of uncertainty in the field study are related to the accuracy of test measurements, the appropriateness of media, sampling, and testing protocols, and the proper selection of sampling locations. Through strict adherence to the guidelines put forth in the Sampling and Analysis plan, uncertainty associated with the results of the field study will be sufficiently reduced such that the data is legally and scientifically defensible. Measures implemented to ensure this level of data quality include adherence to quality assurance guidelines designed to meet the project DQOs, inclusion of sampling and analysis methods that are well established and accepted in risk assessments, performance of the investigation by appropriately skilled project staff, and multiple checks on data quality prior to use in the risk assessment (i.e., third-party data validation, peer review). The data generated by the field study will represent the Site conditions during a specific time period and does not consider changes in COPEC concentrations, bioavailability, or COPEC sequestration due to temporal effects.

2.5.3 Assumptions

The principal assumption of the field study is that the lines of evidence generated by the field study will be sufficient to satisfy the assessment endpoints and that the data will be an adequate indicator of toxicity associated with COPECs present in the Site sediments. The uncertainty related to these assumptions is based on several factors, including the limitations of the test protocols in identifying effects caused by specific COPECs, toxicity effects due to

environmentally modified or biotransformed compounds, and other variables that are not understood using currently available technology.

Other assumptions include:

- The results of the toxicity testing will be indicative of the effects of the COPECs;
- The pore water analytical results are representative of bioavailability;
- Bulk sediment analytical results coupled with TOC and AVS/SEM analyses are representative of bioavailability; and
- Differences in results between reference samples and target samples are a result of differences in chemical concentrations or bioavailability in the sediments.

3.0 STUDY DESIGN

This section discusses the BERA study design. The study design involves selecting compounds, media, and organisms to be analyzed at the target and reference stations.

3.1 DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) were established for the BERA through the Problem Formulation steps, which used the conceptual model to identify the assessment endpoints and risk questions identified in Table 1.

As noted in Section 1.0, the overall objective to be addressed by the BERA is to evaluate the specific contaminants, pathways, and receptors identified in the SLERA as warranting additional investigation. DQOs are based on the proposed end uses of data generated from sampling and analytical activities. DQOs are qualitative and quantitative statements that outline the decision-making process and specify the data required. DQOs are typically developed through a seven-step process (EPA, 2000). However, the DQO development process for ecological risk assessments is constrained by several factors, including the lack of specific criteria for ecological endpoints, the potential for multiple endpoints, and the use of weight-of-evidence evaluations of different measurement types (e.g., contaminant concentrations, bioassay tests). Given these limitations, the steps of the DQO process have been completed in a manner to produce qualitative and quantitative statements to develop an appropriate study design to address the needs of the BERA.

3.2 STUDY DESIGN

To address the BERA and the objectives, an investigation program has been developed to use multiple lines of evidence including sediment toxicity testing, surface water toxicity testing, measures of COPEC bioavailability, and COPEC concentration data.

The investigation program includes bioassays of estuarine invertebrates coupled with chemical analyses of sediment, pore water, and surface water. The bioassays, chemical analyses, and determination of COPEC bioavailability represent three lines of evidence which will be used to support the conclusions of the BERA. The analyses have been selected to incorporate the media,

pathways, and COPECs relevant to the assessment endpoints. Sampling, analysis, and data evaluation protocols have been selected to ensure that the data collected is scientifically defensible and applicable to the BERA objectives.

Samples of bulk sediment for chemical analyses and bioassays, and pore water samples collected for chemical analyses, will be co-located and collected concurrently. Sample station locations have been selected based on the number and magnitude of COPECs with HQs >1 as shown on Table 3. Proposed sampling locations are provided on Figures 5 through 8, and the selection rationale provided in Section 3.4.

During the problem formulation step, hazard quotients greater than one for soil invertebrates were calculated for two compounds at soil sample location SB-204 in the North Area. The COPECs 4,4'-DDT and Aroclor-1254 had hazard quotients of 9 and 3, respectively, in a sample from this location. This sample location is located south of the former surface impoundments in an area that will be covered as part of the previously mentioned pending Removal Action for repair of the former surface impoundment cap. COPECs, 4,4'-DDT and Aroclor-1254, and the soil exposure pathway in this area were carried forward from the problem formulation; however, based on the pending Removal Action, soil samples are not included in the ecological investigation study design.

3.3 ANALYTICAL METHODS

Bioassays

Toxicity analyses will be performed on wetland and estuarine sediments and estuarine surface water using standard bioassay techniques. The goal of the bioassays will be to quantitatively assess ecological and biological impacts related to the COPECs found in sediment and surface water at the Site. Sediment bioassay tests will be performed using benthic invertebrates which are intimately associated with sediments due to their burrowing activity or consumption of sediment particulates. Sediment samples collected for bioassay analyses will be co-located and collected concurrently with sediment samples and sediment pore water collected for chemical analyses to ensure correlation among the data. Reference sediment samples will be collected from un-impacted areas to serve as controls for the bioassay analyses. Chronic bioassays utilizing both amphipods and polychaetes have been selected. The 28-dat chronic bioassay using

the amphipod *Leptocheirus plumulosus* and the 28-day chronic bioassay using the polychaete *Neanthes arenaceodentata* have been selected as the most appropriate method for evaluating the sediment toxicity at the Site.

Leptocheirus plumulosus was selected because this species is representative of the common anthropods found in Texas gulf coast bay systems, and because long-term bioassay information is available. The *Leptocheirus* bioassay tests will use growth, mortality, and reproduction as measurement endpoints. *Neanthes arenaceodentata* were selected because they burrow and ingest sediment which represents significant exposure potential, and they represent one of the most abundant groups of benthic organisms found on the Texas gulf coast. The growth endpoint will be used for this study, with mortality data used only to assist in growth calculations. Both test organisms are sensitive to the Site COPECs, tolerant to a wide range of sediment and salinity conditions, and have been used extensively in bioassay tests.

Surface water toxicity at the Site will be evaluated through the use of a 7-day chronic bioassay analysis that measures survival and growth of *Mysidopsis bahia.* This bioassay was selected based on the appropriateness of the organism for site conditions and the sensitivity of the organism to the COPEC, copper.

Test procedures for the bioassay analyses discussed in this section are provided in Appendix A.

Sediment chemical analysis

Sediments collected as part of the BERA investigation will be analyzed for Site COPECs, Acid Volatile Sulfides/Simultaneously Extracted Metals (AVS/SEM), and Total Organic Carbon (TOC). According to the EPA guidance document *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites* (EPA, 2005a), "Concentrations of bulk (total dry weight basis) metals in sediment alone are typically not good measures of metal toxicity. However, in addition to direct measurement of toxicity, EPA has developed a recommended approach for estimating metal toxicity based on the bioavailable metal fraction, which can be measured in pore water and/or predicted based on the relative sediment concentrations of acid volatile sulfides (AVS), simultaneously extracted metals (SEM), and total organic carbon (TOC) (U.S. EPA 2005c). Both AVS and TOC are capable of sequestering and immobilizing a range of metals in sediment". AVS/SEM analysis will not be performed at Intracoastal Waterway sampling

locations since no metal concentrations in Intracoastal Waterway sediments resulted in HQs greater than one.

Sediment pore water analysis

Sediment pore water will be analyzed for the COPECs indicated on Table 3 and will generally correspond to the COPECs of interest in the associated sediment.

Sediment physical properties analysis

The physical properties of Site sediments were evaluated as part of the RI/FS investigation conducted in 2006. The findings of the RI/FS (report pending) indicate consistent sediment grain size distribution throughout the investigation area, therefore, sampling and analysis to evaluate the grain size distribution of sediment samples is not proposed as part of this investigation.

Surface water analysis

Surface water samples will be analyzed for dissolved copper using EPA method 6010/6020 as indicated on Tables 2 and 3.

3.4 STATION LOCATIONS AND RATIONALE

Sampling locations selected for the field study were chosen based on the results of the BERA the problem formulation which identified the areas of the Site most likely to be at risk for ecological degradation. Sample locations were based on the magnitude of HQs, the number of analytes with HQs>1, and the overall number of samples in a specific area with these characteristics. Sediment sampling locations in the wetland area were selected to focus on locations where the HQ was greater than 3. By this rationale and consistent with the similar characteristics between wetland and pond sediments and the shallow nature of the "Small Pond", a sediment sample from the "Small Pond" area was not included in the study design. Reference sample locations were selected to be representative of un-impacted Site conditions. Specific sample locations and rationale for selection are presented in Section 4.2 and summarized on Table 3. Areas of the Site that will be covered by the pending Removal Action to repair the former surface impoundments cap, including the area immediately south of the former surface impoundments, are not proposed for sampling.

3.5 DATA INTERPRETATION PROCEDURE

Data generated during the site investigation and analysis phase of the BERA will be used to characterize risk in relationship to the assessment endpoints established in the Problem Formulation. Risks to the assessment endpoints will be determined using a lines-of-evidence approach as described in *Guidelines for Ecological Risk Assessment* (EPA, 1998). During this process, each factor will be carefully examined and evaluated for its importance in characterizing risk assessment endpoints. This approach to risk analysis will rely on quantitative methods of evaluating the measures established for the investigation, including statistical analysis and comparison of data to media toxicity benchmark values.

Bioassay tests will be performed by an experienced and accredited laboratory with appropriate replicates and quality control measures to ensure strong statistical reliability and accuracy of test results. Quality control measures will be documented and later included as an appendix to the BERA. Bioassay test results will be compared to the results obtained from reference samples collected from the same media near the Site. Bioassay results will also be compared to laboratory control samples. The performance of the reference sample bioassays will be used as a control measure to distinguish between toxicological effects likely caused by Site COPECs or toxicological effects resulting from environmental factors (naturally occurring site conditions or laboratory environment). Following validation of the bioassay results and incorporation of reference sample impacts, bioassay data will be evaluated against other applicable lines of evidence, such as bioavailability and concurrently measured COPEC concentrations, to derive statements that are appropriate to address the assessment endpoints.

Chemical analysis of interstitial water and bulk sediment, as well as TOC and AVS/SEM, will be evaluated using established techniques (e.g., equilibrium partitioning) to determine the site-specific bioavailability of Site COPECs. The bioavailability characteristics of the COPECs will be further refined through the use of a literature search to ensure they are applied appropriately. COPEC bioavailability will be incorporated into the overall assessment of the investigation results and conclusions of risk characterization later in the BERA.

COPEC concentrations in environmental media (i.e., surface water, sediment) will be used to correlate bioassay and bioavailability results to toxicological effects, or lack thereof, of specific

COPECs. Concentration data will be used to establish hazard quotient values necessary to evaluate ecological risk at the Site.

4.0 FIELD SAMPLING PLAN

4.1 SAMPLING TYPES AND OBJECTIVES

4.1.1 Sediment Sampling

Sediment sample stations will be selected based on investigation requirements and the rationale presented in Section 3.4. A sample station map will be developed and the sample station coordinates will be determined before sampling is initiated. Sediment samples collected from each location for chemical analysis, pore water extraction, and toxicity testing will be collected at the same time (concurrent and co-located).

Sampling will be conducted from a boat, skiff, on foot, or other appropriate sampling platform as conditions indicate. Sampling in areas inaccessible by watercraft will be conducted by wading to the sample stations. A differential GPS receiver with sub-meter accuracy will be used to locate the stations and record actual coordinates, as detailed in Section 4.2. Sample station information, sample depth, and all other pertinent observations made during the study will be recorded on field data sheets. The following sections describe the basic sediment sampling procedures for the various techniques to be employed during the investigation.

Marsh and Wetland Sediment

Sediment will be collected from the intertidal marsh by approaching the sample site on foot, being careful not to impact the area to be sampled. The sample will be collected using a stainless steel scoop or spoon, and will be placed in a stainless steel bowl for homogenization. Aliquots of the sample will be removed from the bowl and placed in pre-cleaned labeled sample jars. Equipment used for sample collection, sub-sampling, and sample mixing (i.e., spoons, knives, scoops) will be stainless steel or Teflon®. Sediment samples collected for AVS/SEM analysis will be collected and transported in a manner specified by the laboratory to reduce the likelihood of exposure to atmospheric conditions.

Intracoastal Waterway Sediment

Soft surficial sediment samples will be collected using an Ekman grab (or equivalent). The jaws of the sampler will be locked open and the sampler will be lowered to the bottom on a cable or attached to a stainless steel pole. To prevent forward wake, the sampler will not be lowered faster

than 0.3 m/sec as it nears the bottom. The sampler will be retrieved slowly to ensure proper jaw closure. The retrieved sampler will be lowered into a clean tub or tray, and secured in an upright position to prevent sediment movement. Collection of sediments using an Ekman or Ponar Grab device is also described in SOP-BESI-101 previously provided in the RI/FS Field Sampling Plan (PBW, 2006b).

A sediment sample will be acceptable if its depth is greater than 6 inches and the surface is relatively flat and undisturbed. If a sample is not acceptable it will be set aside (do not dump overboard), and a second sample will be collected. Unacceptable samples will be discharged overboard after an acceptable sample is collected.

Prior to removing sediments from the sampler, overlying water will be drained by gently tilting it. A 0 to 6-inch sub-sample will be collected from the top of the closed sampler using a pre-cleaned spoon, scoop, or core tube. Sediment will be removed using pre-cleaned spoons and composited in pre-cleaned stainless steel bowls. Only the sediment from the center of the grab sampler (i.e., no sediment touching the walls of the sampler) will be used. Equipment used for sample collection, sub-sampling, and sample mixing (i.e., spoons, knives, scoops) will be stainless steel or Teflon®. Sediment samples collected for AVS/SEM analysis will be collected and transported in a manner specified by the laboratory to reduce the likelihood of exposure to atmospheric conditions.

Core Sampler

Samples of stiff sediment samples from the Intracoastal Waterway, Fresh Water Pond, and/or Small Pond may be collected using a piston-coring device if the grab sampler is not effective at collecting a representative sample. The coring device consists of a 3-inch diameter polycarbonate core tube attached to the end of an aluminum pole. The coring device will be manually driven into the sediment until firm resistance is detected. In the event that a single core does not provide the volume of material required by the analytical laboratory (approximately 1 liter), additional cores will be collected at that station to provide the required sediment. All cores samples from the same station will be combined and homogenized before aliquots are removed.

Sediment from 0-6 inches will be extruded into a stainless steel bowl and will be homogenized and placed in containers for other analyses.

The empty sampler (Ekman or core) will be rinsed and decontaminated following the procedures presented in Section 5.11. The sampler and associated equipment will be decontaminated before use, and between sample sites. In addition, the sampler will be rinsed with Site water before samples are collected.

4.1.2 Pore Water Sampling

Sediment pore water samples will be co-located with bulk sediment sample stations and will be collected concurrently with bulk sediment samples. Sediment samples collected for pore water analyses will be collected using a piston corer (SOP-BESI-102, RI/FS Field Sampling Plan, PBW, 2006b). Several 2 to 3 ft long core tubes will be collected at each station and the upper 10 to 20 cm of sediment used for processing. Sediment samples will be kept in the core tube after sampling, capped, and transported to the processing area without disturbing the sediment. Processing will consist of centrifuging aliquots of the sediment samples until the pore water is separated from the sediment. The pore water is removed using a syringe and then filtered into a standard sample container. Due to the difficulty associated with pore water extraction and the limited volume of pore water generated, some detection limits may be elevated due to limited sample volumes.

4.1.3 Surface Water Sampling

Surface water samples will be collected from one location north of the wetlands north of Marlin Avenue. The surface water sample will be collected from the water surface using a bailer, dip sampler or other discrete depth sampling equipment. Surface water sampling will be conducted in accordance with the SOP provided in the RI/FS Field Sampling Plan (SOP 10, Water Quality Sampling, PBW, 2006b).

4.2 SAMPLING LOCATIONS, TIMING, AND FREQUENCY

Proposed sampling locations are presented on Figures 5 through 8, and summarized on Table 3. The sample locations and rationales for selection are also presented on Table 3.

Locating Proposed Sampling Stations

Sample stations will be located in the field using the coordinates extrapolated from proposed sample locations on the Site maps. A GPS receiver will be used to locate the proposed sampling sites in the field. The GPS unit will utilize real-time corrections to achieve the horizontal coordinates with sub-meter accuracy. Accuracy of the sample locations is important to mapping analytical results, so a relatively high degree of confidence is needed as to where each sample is collected, and if needed, the sample location can be reacquired for future efforts. The desired coordinates will be programmed into the GPS and the receiver can then guide the user to the desired coordinates. However, the proposed sampling locations may be modified in the field based on field conditions and professional judgment. If samples are collected from a sampling vessel, the sampling vessel will be secured at the station using a minimum of two anchors (one placed off the bow and one placed off the stern) to ensure the effects of crosswinds and/or tides are minimized.

Sampling Frequency and Timing

The investigation is planned as a one-time sampling event that will not require additional routine sampling events. The sampling event will be conducted within a reasonable timeframe following approval of the applicable project documents. Depending on the specific analytical methods chosen for the investigation, seasonal influences on bioavailability may be factored into the timing of the sampling event.

4.3 SAMPLE DESIGNATION

The station and sample numbering system for the project has been designed to uniquely identify each sampling station and sample. This numbering system consists of the sample location identifier, depth (if applicable), and QA/QC identifier (if applicable). Sample locations will typically correspond to previous sampling locations that indicated an exceedance during the SLERA.

Sample locations will be designated by the investigation identifier "E" for "ecological risk assessment", followed by a Site location identifier i.e., "W" for wetland, followed by the sample type, i.e., SED, followed by the locations number (1, 2, 3…). Depth intervals in feet below grade will be assigned to sediment samples to designate the vertical sample location. Pore water

samples will have the identifier "PW" appended to the sample ID. As an example, a sediment sample collected from 0 to 6 inches deep in the Intracoastal Waterway at sample station No. 1 will be designated as follows:

Sample ID: EIWSED01 (0-6)

A sample of pore water collected at this location would be assigned a sample ID of "EIWSED01PW".

Field quality control samples such as matrix spikes and matrix spike duplicates and field duplicates, which are detailed in the QAPP, will be designated with the primary sample identification and a quality control suffix as noted below.

Quality Control	Suffix Description	Sample Frequency
MS/MSD	Matrix spike/duplicate	1 per 20 samples per media
FD	Field duplicate	1 per 20 samples per media
EB	Equipment rinsate blank	1 per day/team
FB	Field blank	1 per day/team

To prevent misidentification of samples, labels will be affixed to each sample container. Information will be written on the label with a permanent marker. The labels will be sufficiently durable to remain legible even when wet and will contain the following information:

- Project identification number;
- Sampling station identification name;
- Name or initials of collector;
- Date and time of collection;
- Analysis required (if space on label allows); and
- Preservative inside bottle, if applicable.

4.4 SAMPLING EQUIPMENT AND PROCEDURES

4.4.1 Field Data, Equipment, and Instrument Calibration

Field data will primarily be direct observations, hand measurements, direct-readings from field meters. These data will be tabulated and included in project reports or submittals, as appropriate. Appropriate field forms will be used to record field data collection activities.

Samples will be collected following the sampling procedures documented in this FSP. The equipment used to collect samples, time of sample collection, sample description, volume and number of containers, preservatives added (if applicable) will be recorded on the appropriate field forms.

All field monitoring equipment will be calibrated at the beginning of each day before sample collection and when in use, if necessary. For each meter, recalibration requirements will be based on the manufacturer's guidelines and appropriate SOPs.

A Chain of Custody document will be initiated for the samples, and the appropriate information will be recorded on both the field-log sheet and chain document, as detailed in Section 5.4.

4.5 SAMPLE HANDLING

Samples will be preserved as indicated in Section 5 (QAPP), and stored, as necessary, on ice until shipped to the laboratory for analysis. To meet sample holding times, the samples will be packed in coolers and shipped as soon after collection as practical. Sample volumes, preservative, and holding time requirements are summarized on Table 5.

Samples will be placed in shipping coolers containing bagged, cubed ice immediately following collection. The samples will be grouped in the shipping cooler by the order in which the samples are collected. Samples will be shipped to the laboratory via an overnight courier service, generally on the day they are collected. The only exceptions to this procedure will be for samples collected after the courier service has picked up the shipment for the day and samples collected on a Sunday or holiday. In these instances, the samples will be shipped on the next business day.

Specific protocols are included in PBW SOP-6: *Sample Custody, Packaging and Shipment* provided in the RI/FS Field Sampling Plan (PBW, 2006b).

Evidence of collection, shipment, and laboratory receipt must be documented on a Chain-of-Custody record by the signature of the individuals collecting, shipping and receiving each sample. A sample is considered in custody if it is:

- In a person's actual possession;
- In view, after being in physical possession;
- Sealed so that no one can tamper with it, after having been in physical custody; and/or
- In a secured area restricted to authorized personnel.

Chain-of-Custody Records will be used, by all personnel, to record the collection and shipment of all samples. The Chain-of-Custody Record may specify the analyses to be performed and should contain at least the following information:

- Name and address of originating location of samples;
- Name of laboratory where samples are sent;
- Any pertinent directions/instructions to laboratory;
- Sample type (e.g., aqueous);
- Listing of all sample bottles, size, identification, collection date and time, and preservative, if any, and type of analysis to be performed by the laboratory;
- Sample ID;
- Date and time of sample collection; and
- Signature of collector as relinquishing, with date/time.
- The Chain-of-Custody procedure will be as follows:

The field technician collecting the sample shall be responsible for initiating the Chain-of-Custody Record. The names of all members of the sampling team will be listed on the Chain-of-Custody Record. Samples can be grouped for shipment on a common form.

Each time responsibility for custody of the samples changes, the receiving and relinquishing custodians will sign the record and note the date and time.

1) The Chain-of-Custody Record shall be sealed in a watertight container, placed in the shipping container, and the shipping container sealed prior to giving it to the carrier. The carrier waybill shall serve as an extension of the Chain-of-Custody Record between the final field custodian and receipt in the laboratory. The commercial carrier is not considered part of the COC chain and is not required to sign the COC.

2) Upon receipt in the laboratory, a designated individual shall open the shipping containers, measure and record cooler temperature, compare the contents with the Chain-of-Custody Record, and sign and date the record. Any discrepancies shall be noted on the Chain-of-Custody Record.

5) If discrepancies occur, the samples in question shall be segregated from normal sample storage and the project manager will be notified for clarification.

6) Chain-of-Custody Records, including waybills, if any, shall be maintained as part of the project records.

4.6 SAMPLE ANALYSIS

4.6.1 Proposed Laboratories

Bioassay

Aquatic Bioassay & Consulting Laboratories, Inc. (ABC)
29 North Olive Street
Ventura, California
(805) 643-5621

AVS/SEM

TestAmerica
301 Alpha Drive
Pittsburgh, PA 15238-2907
(412) 963-7058

Chemical Analyses

ABC will subcontract samples to a NELAC Certified laboratory (to be determined)
The laboratories chosen to provide analytical services for the BERA were selected based on historical performance and areas of technical expertise related to ecological risk assessments. SOPs for test methods provided by the laboratory are provided in Appendix A. A Statement of Qualifications and Quality Assurance/Quality Control Manual for ABC is provided in Appendix B. ABC will perform toxicity testing and will subcontract sample for chemical analyses to a NELAC certified laboratory.

4.6.2 Chemistry Analysis Methods

Chemistry analyses will be conducted according to established EPA or ASTM methods. The analytical methods selected for use during this investigation are presented in Table 2 and listed below:

- Metals – US EPA Method 6010/6020
- PAHs and hexachlorobenzene – US EPA Method 8270
- Organochlorine Pesticides – US EPA Method 8081
- TOC – SW846 Method 9060
- AVS/SEM – US EPA Draft Analytical Method EPA/821/R-91/100

4.6.3 Toxicity Testing Methods

Bioassay tests were selected based on the appropriateness of the test organism relative to the physical characteristics of the Site (salinity, sediment grain size, etc.) and sensitivity to the Site COPECs. The specific species were selected because of their interaction with sediment (burrowing and ingestion), they are representative of one of the most abundant groups of benthic organisms found in Texas bays (polychaetes), they represent one of the most abundant groups of crustaceans found in Texas bays (amphipods), and they have been used extensively in similar ecological assessments. Toxicity tests selected for use in the ecological risk assessment are provided on Table 2 and listed below. The test procedures and data validation procedures for bioassay tests are provided in the SOPS included in Appendix A.

Sediment

- 28d chronic (growth, survival, reproduction) bioassay using *Leptocheirus plumulosus*
- 28d chronic (survival) bioassay using *Neanthes arenaceodentata*

Surface water

- 7d chronic (growth and survival) bioassay using *Mysidopsis bahia*

4.7 CONTINGENCIES

This section describes contingency procedures to be used if a portion (or portions) of the steps described in this Work Plan cannot be performed. Contingency planning includes informing the EPA of problems encountered and alternate actions being considered. The EPA will also be notified of other problems that may be encountered during sample collection and transport, such as sample loss or container breakage.

The type of contingency procedures required (e.g., departures or deviations) will be recorded on field sheets. EPA will be informed of all deviations, considered one-time occurrences, as soon as is practical.

5.0 QUALITY ASSURANCE PROJECT PLAN

5.1 PROJECT DESCRIPTION

This QAPP has been prepared for the BERA at the Gulfco Marine Maintenance Site. The BERA Work Plan that includes this QAPP describes the project background and investigation objectives, including the site description and history, the project objectives, and the sample network design and rationale. The FSP describes procedures to be implemented in the field. Investigation specific procedures and protocols for sample collection, chain-of-custody, sample handling, sample analysis, and report preparation are included in this QAPP or by reference to the previously submitted Sampling and Analysis Plan (SAP) included in the RI/FS Work Plan prepared for the Site (PBW, 2006c). The QAPP is organized in accordance with basic EPA guidelines for the preparation of QAPPs.

The goal of the QAPP is to assure that the data collected meet the project objectives established in Section 3.1. All QA/QC procedures will be in accordance with applicable professional standards, government regulations and guidelines, and specific project goals and requirements.

5.2 QA/QC ORGANIZATION AND RESPONSIBILITIES

Respondent's Project Coordinator

The Respondent's Project Coordinator will direct and supervise all BERA work. The Project Manager's responsibilities will be to review all BERA project work to ensure that it meets the specific project goals, meets technical standards, and is in accordance with the objectives and procedures discussed herein.

BERA Investigation Manager

The BERA Investigation Manager will direct and supervise all BERA work. The BERA Investigation Manager's responsibilities will be to review all BERA project work to ensure that it meets the specific project goals, meets technical standards, and is in accordance with the objectives and procedures discussed herein.

QA Manager

The QA Manager will remain independent of direct involvement in day-to-day operations, but will have direct access to staff, as necessary, to resolve any QA issues. The QA Manager has sufficient authority to stop work on the investigation as deemed necessary in the event of serious QA/QC issues. Specific functions and duties include:

- Performing QA audits on various phases of the project's operations, as necessary;
- Reviewing and approving this QAPP and other QA plans and procedures;
- Performing validation of data collected relative to risk assessment activities and this QAPP; and
- Providing QA technical assistance to project staff.

The QA Manager will notify the Project Coordinator of particular circumstances that may adversely affect the quality of data and ensure implementation of corrective actions needed to resolve nonconformances noted during assessments.

Field Supervisor

The Field Supervisor will be responsible for all aspects of field work performed as part of a specific risk assessment activity. Different project subtasks or activities may have different Field Supervisors. Duties of the Field Supervisor will include:

- Maintaining field records;
- Continually surveying the Site for potential work hazards and relate any new information to site personnel at the Tailgate Safety Meeting held each day prior to beginning field activities.
- Ensuring that field personnel are properly trained, equipped, and familiar with Standard Operating Procedures and the Health and Safety Plan;
- Overseeing sample collection, handling and shipping; ensuring proper functioning of field equipment; and
- Informing the laboratory when samples are shipped to the lab and verifying samples arrived at the lab.

The primary duty of the Field Supervisor is to ensure that the field sampling is performed in accordance with the project sampling plans and this QAPP. The Field Supervisor will also require that appropriate personal protective equipment will be worn and disposed of according to the Health and Safety Plan provided in the RI/FS SAP prepared for the Site (PBW, 2006b). In addition, the Field Supervisor may be responsible for preparing monitoring reports for review by the Project Manager.

Laboratory QA Manager

The laboratory QA Manager will have overall responsibility for data generated in the laboratory. The laboratory QA Manager will be independent of the laboratory production responsibilities, but will communicate data issues through the PBW Project Manager. In addition, the laboratory QA Manager will

- Monitor the day-to-day quality of the laboratory data.
- Maintain and review all quality control data.
- Conduct internal performance and system audits to ensure compliance with laboratory protocols.
- Review and maintain updated Standard Operating Procedures (SOPs).
- Prepare Performance Evaluation reports and corrective action reports.

5.3 DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) are qualitative and quantitative statements derived from the outputs of each step of the DQO process. The DQO process is a series of planning steps based on the scientific method that is designed to ensure that the type, quantity and quality of environmental data used in decision-making are appropriate for the intended application (EPA, 2000).

The DQO development process for the BERA was completed through the Problem Formulation and Study Design steps (EPA, 1997), and consisted of:

- Clarifying the study's objective and defining the most appropriate types of data to collect;
- Determine the proper field conditions under which the study should be conducted; and

- Specifying acceptable levels of uncertainty as the basis for establishing the quantity and quality of data needed to support risk management decisions.

Based on the results of the Problem Formulation, measurement endpoints, quantity and quality of data, and acceptable levels of decision error were established as presented in Section 3.0. Performance objectives have been established for each of the Data Quality Indicators (Precision, Accuracy, Completeness, Representativeness, and Comparability) as defined below.

5.3.1 Precision

Precision is a measure of the reproducibility between two or more measurements of the same characteristic (i.e., analyte, parameter) under the same or similar conditions. Determining the agreement among replicate measurements of the same sample assesses the precision of the analytical procedure; combined precision of sampling and analysis procedures is assessed from the agreement between measurements of field duplicate samples. The relative percent difference (RPD) in the results will be computed for each duplicate pair. The RPD is defined as 100 times the absolute value of the difference (range) of each duplicate set, divided by the average value (mean) of the set:

$$\text{RPD} = \frac{\text{ABS}(\text{primary sample result} - \text{duplicate sample result})}{\text{average of primary and duplicate sample result}} \times 100$$

Field Precision Objectives

Precision of sampling and analysis procedures will be assessed through the collection of field duplicate samples. Data for duplicate analyses will be evaluated only if both of the samples in the duplicate pair have a concentration greater than the method quantitation limit (MQL). It is noted here that natural variation in some of the matrices will affect how closely these goals are met; that is, if variation is high, then these goals are unrealistic. Consequently, RPD results from field duplicates will not be used as a basis for invalidating any analytical data.

Laboratory Precision Objectives

Precision of the analytical procedure will be assessed through duplicate analyses of laboratory QC and field samples. Data for duplicate analyses will be evaluated only if both of the samples in the duplicate pair have a concentration greater than the method quantitation limit (MQL).

5.3.2 Accuracy

Accuracy is a measure of the bias in terms of the degree of agreement between an observed value (i.e., sample result) and the accepted reference or true value. Accuracy is expressed as the percent recovery of spiked analytes. The equations used to calculate percent recovery is:

$$\% \text{ Recovery} = \frac{\text{measured amount}}{\text{known amount}} \times 100$$

Laboratory blank samples and field blanks will also be used to quantify the effect of sample contamination on overall data accuracy.

Field Accuracy Objectives

The potential for field contamination will be assessed through collection of equipment blanks (when non-dedicated sampling equipment is used) and trip blanks (as needed) and adherence to all sample handling, preservation and holding time requirements.

Laboratory Accuracy Objectives

Laboratory accuracy will be evaluated by the analysis of laboratory control samples (LCS), matrix spike (MS) samples and surrogate spikes (SU), with results expressed as a percentage recovery measured relative to the true (known) concentration. In addition, laboratory preparation blank results will be used to measure any contamination introduced during the analytical process. The objectives for minimizing the effect of laboratory contamination on sample accuracy are concentrations less than the MQL in all blank samples.

5.3.3 Completeness

Completeness is the percentage of valid measurements or data points obtained, as a proportion of the number of measurements or data points planned for the project. Completeness is affected by such factors as sample bottle breakage and acceptance/rejection of analytical results.

Completeness will be re-calculated and presented in each validation checklist. If completeness approaches the established goal (within 2-3%), corrective action will be instituted as described in Section 5.9. The completeness goal on a sample level is 90% and the goal on an analyte level is 80%.

5.3.4 Representativeness

Representativeness is a qualitative objective, defined as the degree to which data accurately and precisely represents the characteristic of a population, the parameter variations at a sampling point, the process condition, or an environmental condition within a defined spatial and/or temporal boundary.

Field Representativeness Objectives

Field representativeness is achieved by collecting a sufficient number of unbiased (representative) samples and implementing a QC program for sample collection and handling prior to analyses. The sampling approaches developed for this project will provide for samples that are representative of site conditions. Any equipment blank and field blank results will also be evaluated to ensure that analytical results are representative of sample concentrations.

Laboratory Representativeness Objectives

Representativeness in the laboratory is ensured by using the proper analytical procedures, appropriate sample handling and preparation methods, meeting sample holding times and analyzing and assessing duplicate samples.

Comparability

Comparability is the confidence with which one data set can be compared to another.

Measures to Ensure Comparability of Field Data

Comparability is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the standard field protocols in the FSP are consistently followed and that the sampling techniques specified in the sampling plan are consistently used.

Measures to Ensure Comparability of Laboratory Data

Planned analytical data will be comparable when the sampling and analytical methods described in the FSP and in this QAPP are used for sample collection and laboratory analysis. This goal is achieved through the consistent use of standard techniques to collect and analyze representative samples. Results of sample analyses will be consistently reported in appropriate units. Comparability is also dependent upon the laboratory obtaining the QA objectives for accuracy and precision. All data that meet the QA objectives described in this document and are considered usable will be considered comparable data.

5.4 SAMPLING PROCEDURES

Project sampling processes were designed to obtain information necessary to address those data needs described in the CSM, and identified during the BERA Problem Formulation step. Field sampling procedures employed during the ecological risk assessment will be consistent throughout the project, thus providing data representative of site conditions, comparability with analytical considerations, practicality, and simplicity. Procedures for all aspects of collection, preservation, and transport of samples are provided in the FSP.

5.4.1 Sampling Methods

Sampling methods are described in Section 4.0 of this Work Plan. SOPs for these methods are provided in Appendix A of the RI/FS FSP (PBW, 2006b) or in Appendix A of this Work Plan for SOPs unique to this WP.

Sample Volume, Containers, and Preservation

The sample volume, container and preservation requirements will be in accordance with requirements for the specific analytical methods. This information is provided in Appendices C and D of the RI/FS QAPP (PBW, 2006c), and on Table 5 or in Appendix A of this Work Plan for SOPs unique to this WP and SAP.

5.4.2 Sampling Quality Control Requirements and Acceptability Criteria

Field Duplicate

Field duplicates will be collected for chemical analyses at the frequency of one per 20 field samples collected or at least one per sampling day (excludes bioassay samples). A field duplicate is defined as a second sample (or measurement) from the same location, collected in immediate succession, using identical techniques. The duplicate sample will be collected from the same homogenized composite material as the sample it is duplicating and will be submitted "blind" (i.e., without identifying it as a duplicate). Duplicate samples are sealed, handled, stored, shipped, and analyzed in the same manner as the primary sample. Precision of duplicate results is expressed by the RPD between the results of the two samples.

Field Splits

Field splits are not required for any of the activities, but may be requested by the EPA. A field split is collected in the same manner as a field duplicate.

Equipment Blanks

Equipment blanks (rinsate) blanks may be collected when sampling requires the re-use of non-dedicated equipment. If required, equipment blanks will be collected once per day, from decontaminated sampling equipment and analyzed for the COPECs of interest. When possible, rinsate blanks will be collected from the final rinse water of non-dedicated decontaminated equipment to assess the effectiveness of the cleaning and decontamination procedure.

Trip Blanks

Trip blanks are typically included in sample shipping containers to evaluate the potential for contamination from VOCs during sample transport. Since trip blanks are used only when samples are collected for volatile organic compounds analyses, not all activities will require trip blanks.

5.4.3 Field Sample Handling and Custody

Chain-of-Custody (COC)

Proper sample handling and custody procedures ensure the custody and integrity of samples beginning at the time of sampling and continuing through transport, sample receipt, preparation, analysis, and disposal.

A sample is in custody if it is in actual physical possession or in a secured area that is restricted to authorized personnel. The COC form is used to document sample handling during transfer from the field to the laboratory and among contractors. The list of items below should be included on the COC form.

- Site identification
- Sample identification
- Date and time of collection
- Sample matrix
- Container type
- Number of containers
- Preservative used
- Notation if the sample was filtered
- Analyses required
- Name and signature of collector(s)
- Custody transfer signatures and dates and time of transfer
- Name of laboratory admitting the samples
- Bill of lading (if applicable)

Sample Labeling

Sample labels are completed with an indelible, waterproof marker. Label information includes the sample identification number, the date and time of sampling and sample type. The sample identification numbering system for the project has been designed to uniquely identify each sampling station and sample. This numbering system consists of a sequential sample location identifier, depth (if applicable), and QA/QC identifier (if applicable), as detailed in the FSP.

Sample Handling

Sample handling procedures for each activity and type of sample are described in the FSP.

Failures in Chain of Custody and Corrective Action

All failures associated with COC procedures are immediately reported to the person who originally signed the COC, typically the Field Supervisor. These include such items as delays in transfer, resulting in holding time violations; violations of sample preservation requirements; incomplete documentation, including signatures; possible tampering of samples; broken or spilled samples, etc. The Project Manager or Field Supervisor, in consultation with the QA Manager, will determine if the procedural violation may have compromised the validity of the resulting data. Any failures that have reasonable potential to compromise data quality will invalidate data, and the sampling event should be repeated. The resolution of the situation will be reported to the Project Coordinator. Corrective action reports will be maintained by the QA Manager.

5.4.4 Laboratory Sample Handling and Custody

Sample Receipt

Upon receipt by the laboratory, sample integrity will be inspected and documented on the COC or associated document (i.e., a sample receipt report or similar document). Information to be noted on the COC includes: name of person inspecting cooler, integrity of custody seals, sample cooler temperature, evidence of preservation, physical condition of sample container, and airbill number. The COCs will be reviewed for completeness. If any sample integrity or sample ID problems or discrepancies are found, the Field Supervisor or Project Manager will be notified immediately. A COC addendum or sample receipt report may be used to document the corrective actions used to address any COC discrepancies. If an addendum is not used, corrective actions used to correct COC discrepancies must be recorded directly on the COC. Samples will be stored in a specially designated area that is clean, dry, and refrigerated (if needed).

Sample Labeling

The field sample number will be recorded on the sample inventory, the COC, and on the sample label. All samples will be assigned discrete sample identification numbers (sample control numbers) upon receipt by the laboratory. The laboratory sample control number will remain the same throughout the analysis and data entry procedures. Final results will be reported with both the field sample ID and the laboratory sample control number.

Sample Custody

The laboratory will be responsible for maintaining an accurate custody record for each sample in the lab. Records will be maintained to document the date and time the sample is checked out of sample storage for analysis and the date and time at which the sample is returned. The Laboratory Project Manager or laboratory contact will be responsible for supplying the Field Supervisor (or their designee) with a sample acknowledgment form within 24 hours of sample receipt. This form will provide sample receipt information, sample log-in information, and the laboratory project number for the samples. A completed, signed COC will be sent by the laboratory to the Project Manager with the final data report.

5.5 ANALYTICAL PROCEDURES

Analytical methods for investigation activities are presented in Section 4.6 of this Work Plan. SOPs for laboratory analyses included in this investigation are provided in Appendix A. The test methods selected as part of this investigation program are standard EPA or ASTM procedures.

Detailed laboratory QC requirements are contained within each individual method SOP. The minimum requirements for the QC samples are outlined below. Laboratory QC sample results are reported with the data report.

Laboratory Duplicates, Matrix Spikes, and Matrix Spike Duplicates

Duplicate analysis is performed as a measurement of precision on the analytical process. Laboratory duplicates are independently repeated measurements of the same sample, which are performed by the same analyst and under the same conditions. The sample is split in the laboratory and each fraction is carried through all stages of preparation and analysis. The RPD is calculated from the two sample results. The duplicate procedure is performed at least once per 20 samples for chemical analyses (excludes bioassay samples).

Matrix spike samples are prepared by adding a known amount of each target analyte (or a subset thereof) to a known amount of sample. The matrix spike is added at the beginning of the procedure and is carried through the entire measurement process. The sample itself (without a matrix spike) is also carried through the analytical process. In order to produce reliable recovery results, the spike level must be similar to the sample concentration. Because the matrix spike samples are prepared and analyzed at the same time as the sample, only a reasonable estimate of

the spike level can be made. Where samples are collected in field areas that are expected to have high concentrations, they will be identified for the laboratory, and corresponding spike levels can be used. The amount of the spike should be at least four times the amount in the unspiked sample.

The spike recovery measures the effects of interferences caused by the sample matrix in the analytical process. The matrix spike recovery is calculated as follows:

$$\% \text{ Recovery} = \frac{\text{spiked sample result} - \text{sample result}}{\text{theoretical spike concentration}} \times 100$$

For chemical analyses, the matrix spike procedure is performed once per batch of 20 samples. The matrix spike is performed twice and the second spike is called the matrix spike duplicate. This procedure evaluates the precision associated with the procedure and the analyst performing the procedure and is calculated as a RPD as described above.

If a site sample is to be used as an MS/MSD, the sample to be used shall be designated on the COC. The MS/MSD is used to document the bias of a method due to sample matrix, not to control the analytical process and thus laboratory corrective action is not instituted based on MS/MSD results.

Laboratory Control Standard (LCS) and Laboratory Control Standard Duplicates (LCSDs)

The laboratory control sample (LCS) is an aliquot of a solid or aqueous certified reference material containing a known amount of each target analyte being measured. The LCS is treated like a field sample from the beginning of the procedure and is carried through the entire measurement process. The amount of the spike should be at a level less than or equal to the midpoint of the calibration curve for each analyte. For chemical analyses, the LCS is analyzed once per batch of 20 samples.

The percent recovery of the target analytes in the LCS assists in determining whether the procedure is in control. It is further used to evaluate the accuracy and bias of all or a portion of the measurement process. If insufficient quantity of sample is provided to perform a matrix spike

and matrix spike duplicate, a duplicate LCS (LCSD) is prepared and analyzed and the RPD is calculated as described previously.

Detectability Check Sample

For chemical analyses, the laboratory should routinely check the instrument MDL to verify the laboratory's ability to reliably detect the parameter at the MDL that is used for reporting detected results and calculation of non-detected results. The detectability check standard should be routinely analyzed and the results maintained on file with the MDL data.

Method Blank

The method blank is analyte-free water or solid material that is processed simultaneously with and under the same conditions as the samples. For chemical analyses, the method blank is analyzed once per batch of 20 samples to demonstrate that the analytical system itself is not contaminated with the analyte(s) being measured. The method blank results should be below the Method Quantitation Limit or corrective action must be taken. No qualification is warranted if a sample result from the sample group is greater than or equal to five times the associated blank concentration. Analytical results less than five times the associated blank concentration are qualified as non-detected.

Negative Control

A control sediment is one that is essentially free of contaminants and is used routinely to assess the acceptability of a bioassay test; it is not necessarily collected near the site of concern. A control sediment provides a measure of test acceptability, evidence of test organism health, and a basis for interpreting data obtained from the test sediments. Any study in which organisms in the negative control do not meet performance criteria must be considered questionable. The negative control is included in each batch of bioassay test samples.

Positive Control (Reference Toxicant)

A reference-toxicity test is one conducted with reagent-grade reference chemical to assess the sensitivity of the bioassay test organisms response to a toxicant challenge. Deviations outside an established normal range (±2 SD, 95% confidence limits) may indicate a change in the sensitivity

of the test organism population. Reference-toxicity tests are most often performed in the absence of sediment and are performed at least once every six months.

Additional Method Specific QC Requirements

Additional QC samples may be run (e.g., continuing calibration samples), as specified in the method SOPs. The requirements for these samples, their acceptance criteria, and corrective action are method-specific.

Failures in Quality Control and Corrective Action

All qualified data are evaluated by the Project Manager, in consultation with the QA Manager. Since the differences between field duplicate sample results are used to assess the entire sampling process, including environmental variability, the arbitrary rejection of results based on pre-determined limits is not practical. Therefore, the professional judgment of the Project Manager and QA Manager will be relied upon in evaluating results. Rejecting sample results based on wide variability is a possibility. Field blank values exceeding the acceptability criteria may automatically invalidate the sample, especially in cases where high blanks may be indicative of contamination that causes a result to exceed the standard. Field duplicate excursions will be noted. Equipment blank results are also scrutinized very closely. Corrective action will involve identification of the cause of the failure where possible. Response actions may include re-analysis of questionable samples. In some cases, a site may have to be re-sampled to achieve project goals.

Laboratory measurement quality control failures are evaluated by the Laboratory Project Manager and findings reported to the Project Manager.

Standards Traceability

All standards used in the laboratory are traceable to certified reference materials. Standards preparation is fully documented and maintained in a standards log book. Each document includes information concerning the standard identification, starting materials, including concentration, amount used and lot number, date prepared, expiration date and preparer's initials or signature. The reagent bottle is labeled in a way that traces the reagent back to the preparation.

Failures in Measurement Systems and Corrective Actions

In many cases, the field technician or lab analyst will be able to correct problems. If the problem is resolved by the field technician or lab analyst, he/she will document the problem on the field data sheet or laboratory record and complete the analysis. If the problem is not resolvable, then it is conveyed to the Laboratory Project Manager, who will make the determination and notify the QA Manager. If the analytical system failures may compromise the sample results, the resulting data will not be reported. The nature and disposition of the problem is reported on the data report, which is sent to the Project Manager.

5.6 PREVENTIVE MAINTENANCE

5.6.1 Field Instrument Preventive Maintenance

Field instruments are checked and calibrated prior to beginning the field program and daily before use to verify that instruments are in good working order. Routine preventive maintenance procedures are specified in the relevant operation manuals. Additional details on the field equipment to be used in this project are provided in applicable procedures specified in the Field Sampling Plan.

5.6.2 Laboratory Instrument Routine Maintenance Activities

As part of the laboratory QA/QC program, a routine preventive maintenance program will be conducted by the laboratories to minimize the occurrence of instrument failure or other system malfunction. The laboratory workload will be scheduled to accommodate planned downtime required to complete routine maintenance procedures. Trained operators will complete routine maintenance procedures (e.g., changing oven fans, replacing electronic control boards, changing vacuum pump oil, cleaning, etc.) for GC/MS instruments. An inventory of spare parts will be maintained to facilitate timely repair of instruments and minimize downtime.

Records of preventive maintenance activities for each piece of equipment will be maintained in Calibration and Maintenance log books assigned to that instrument. Preventive maintenance performed during the project will be noted in the field logbook and the instrument Calibration and Maintenance log book.

5.6.3 Inspection/Acceptance Requirements for Supplies and Consumables

Supplies and spare parts should be maintained for both field and laboratory instruments to assure timely completion of sample screening and analysis. For field work, critical spare parts such as batteries will be kept on-site to reduce downtime. Backup instruments and equipment should be available on-site or within 1 day shipment to avoid delays in the field schedule.

5.7 DATA MANAGEMENT AND REPORTING

Data management provides a process for tracing the path of the data from their generation in the field or laboratory to their final use or storage. The following elements are included in this process: recording, validation, transformation, transmittal, reduction, analysis, tracking, and storage and retrieval.

Data Recording

Sample collection will be documented and tracked using field log forms, field logbook entries, and Chain-of-Custody Records. Field personnel will complete these forms, which then will be reviewed for correctness and completeness by the Field Supervisor. Copies of these forms will be maintained in the project files.

Data Transformation

Since data will be collected and/or reported using proper units according to this QAPP, no data transformation is expected. If data transformation is necessary, the transformation procedures will be added to this QAPP.

Data Transmittal

The Field Supervisor will be responsible for assuring that field data are entered onto the appropriate field data forms, and will report any problems to the Project Manager. Field Supervisors will submit the complete field data forms to the Project Manager for review and error checking.

Field Supervisors will also ensure that all samples collected in the field are submitted to the laboratory according to the methods outlined in this QAPP or the FSP. The laboratory will

submit to the Project Manager or Field Supervisor the analytical data results in their standard hard-copy format (including raw data format) and in an electronic data deliverable (EDD) format prior to sending the final data report in PDF to the Project Manager. The EDD shall be in space or comma-delimitated ASCII format or in Excel spreadsheet format that will allow for easy integration into a digital database.

Once reviewed by the Project Manager or Field Supervisor for obvious transcription or reporting errors, the final data report in both hard-copy and EDD formats will be transmitted and ready for validation by the QA Manager. Following data validation, any data qualifiers added to data during the validation process will be imported into the project database. Entry or upload of EDDs and data qualifiers into the project database will be completed by a designee of the Project Manager. The data and qualifiers will be initially verified by the individual entering the data. Upon completion of the initial verification step, a report will be generated of the data and verified by the Project Manager against the original data. Only final versions of electronic data will be entered into the database. All electronic data will be verified before and after incorporation into the database against the hard copy reports that accompany the data.

All qualified data will be included with the data packages during all subsequent data transmittal processes. The final hard copy data validation checklists will be included with the data in the final BERA report document.

All field forms and lab data will be organized and stored by sample location allowing for easy access if needed. Data can be transferred electronically either on disc, CD, tape or as an email attachment.

Data Storage and Retrieval

PBW's Project Manager is responsible for project data storage and retrieval. Laboratory data that are stored electronically will be archived electronically, and where printed as part of the paper data report package, will also be archived in paper form. Both the electronic data and hard copies will be maintained in PBW's Round Rock, TX office. In general, all records and data must be retained for a period of 10 years following commencement of construction or of any remedial action which is selected following completion of the RI/FS, per Section XX, Paragraph 79 of the UAO.

5.7.1 Data Review: Verification, Validation, and Integrity

For the purpose of this document, verification means the processes taken to determine compliance of data with project requirements, including documentation and technical criteria. Validation means those processes taken independently of the data-generation processes to determine the usability of data for its intended use(s). Integrity means the processes taken to assure that no falsified data will be reported.

All data obtained from field and laboratory measurements will be reviewed and verified for conformance to project requirements, and then validated against the project objectives. Data supported by appropriate quality control results that meet the project objectives defined for this project will be considered acceptable without qualification. Data associated with quality control results that do not meet the project objectives defined for this project will be assigned appropriate qualifiers reflecting the potential impact on data usability. Analytical data will be considered usable unless rejected during the validation process.

The Field Supervisor is responsible for ensuring that field data are properly reviewed and verified for integrity by reviewing field equipment calibration records and verifying proper field procedures. The Analytical Lab Project Manager is responsible for ensuring that laboratory data are scientifically valid, defensible, of acceptable precision and accuracy, and reviewed for integrity and indicates this by signing the data package Narrative. The QA Manager will be responsible for ensuring that all laboratory data are properly reviewed and verified, and submitted in the required format to the project database. The QA Manager is responsible for validating the laboratory data and documenting the review. Finally, the Project Manager, with the concurrence of the QA Manager, is responsible for verifying that all data to be reported meet the objectives of the project and are suitable for reporting.

Verification and Validation Methods

All data will be verified to ensure they are representative of the samples analyzed and locations where measurements were made, and that the sample results and associated quality control data conform to project specifications. The staff and management of the respective field, laboratory, and data management tasks are responsible for the integrity, validation and verification of the

data each task generates or handles throughout each process. The field and laboratory tasks ensure the verification of raw data, electronically generated data, and information on COC forms and hard copy output from instruments. The Analytical Lab Project Manager will document the review of the reported data per the laboratory's QA Plan.

Verification, validation and integrity review of all laboratory data will be performed or supervised by the QA Manager. The data to be verified are evaluated against project specifications (and are checked for errors, especially errors in transcription, calculations, and data input. The QA Manager will validate all reported laboratory data in accordance with the project Data Validation Standard Operating Procedure found in Appendix F of the RI/FS QAPP (PBW, 2006c) or Appendix B of this Work Plan. All laboratory data will be validated using a Level III data review. For critical samples, a Level IV review may be instituted. The validation will be documented on the Validation Checklist included in the SOPs and data qualifiers will be added to the database as appropriate. The SOPs include guidelines for applying data qualifiers. Generally, data will be rejected for use if the holding time is grossly exceeded or the QC data indicates an extremely low bias (<10% true value) in the measurement.

Potential outliers are identified by the QA Manager and Project Manager by examining results for unreasonable data, or identified using computer-based statistical software. If a question arises or an error or potential outlier is identified, the Field Supervisor or the Analytical Lab Project Manager responsible for generating the data is contacted to resolve the issue. Issues that can be corrected are corrected and documented electronically or by initialing and dating the associated paperwork. If an issue cannot be corrected, the QA Manager and/or the Project Manager will determine the appropriate course of action, or the data associated with the issue are rejected.

The Project Manager and QA Manager are each responsible for validating that the verified data are scientifically valid, defensible, of known precision, accuracy, integrity, meet the project objectives of the project, and are reportable. One element of the validation process involves evaluating the data again for anomalies. The QA Manager or Project Manager may designate other experts familiar with the project to perform this evaluation. Any suspected errors or anomalous data must be addressed by the manager of the task associated with the data before data validation can be completed.

5.8 SYSTEMS AND PERFORMANCE AUDITS

Performance and system audits may be conducted to verify that sampling and analysis are performed in accordance with applicable SOPs specified for field and laboratory activities. The audits of field and laboratory activities include two independent components: internal and external audits.

5.8.1 Field Performance and System Audits

Internal Field Audits

Internal audits of field activities, including sampling and field measurements, will be conducted by the BERA Investigation Manager or a designated alternate. Additional team members may also be present during various phases of the audits. These audits will be conducted to evaluate performance, verify that procedures are followed, and correct deficiencies in the execution of field procedures.

An internal field audit will be conducted at least once at the beginning of the site sample collection activities to verify that established procedures are being followed.

To verify compliance with established procedures and implementation of appropriate QA procedures, internal audits will involve the review and examination of the following: i) field measurement and sampling records, ii) instrument operation and calibration records, iii) sample collection documentation, iv) sample handling and packaging procedures, and v) chain-of-custody procedures. Results of field performance audits will be documented on a field audit checklist. If the first audit reveals significant deficiencies, one or more follow-up audits will be conducted to verify that QA procedures are maintained throughout the remainder of the investigation.

5.8.2 Laboratory Performance and System Audits

Internal Laboratory Audits

Internal system and performance audits at the analytical laboratory will be the responsibility of the Laboratory QA Manager. The internal laboratory system audit will be conducted on an annual basis, and the internal lab performance audit on a quarterly basis. Performance and

systems audits for sampling and analysis operations will include on-site review of laboratory quality assurance systems and on-site review of equipment for calibration and measurement techniques.

External Laboratory Audits

One or more external laboratory audits may be conducted by the U.S. EPA Region 6 Project Coordinator. External laboratory audits will be conducted at the discretion of the U.S. EPA Region 6 Project Coordinator. External lab audits will include, but not be limited to, review of laboratory analytical procedures, laboratory on-site audits, and/or submission of performance evaluation samples to the laboratory for analysis.

5.9 CORRECTIVE ACTIONS

Corrective action is the process of identifying, recommending, approving and implementing measures to counter unacceptable procedures or poor QC performance which can affect data quality. Corrective action can occur during field activities, laboratory analyses, data validation and data assessment. All proposed corrective actions should be documented as well as the steps taken to implement the corrective action. Corrective action should only be implemented after approval by the Project Manager or his designee. If immediate corrective action is required, approvals secured by telephone from the Project Manager should be documented.

For noncompliance problems, a formal corrective action program will be developed and implemented at the time the problem is identified. The person who identifies the problem is responsible for notifying the Project Manager. If the problem is related to an analytical procedure affecting the quality of data produced, this information will be promptly communicated to the Analytical Lab Project Manager, the Project Manager and the QA Manager. Implementation of corrective action will be confirmed in writing through the same channels.

Any nonconformance with the established QC procedures will be identified and corrected in accordance with this QAPP. The Project Manager, or his designee, will issue a nonconformance report for each nonconformance condition and include a copy of this report in the project's files.

5.9.1 Field Corrective Action

Corrective action in the field may be needed when the sample program is changed (i.e., more/less samples, sampling locations or frequencies other than those specified in the WP or FSP) or when sampling procedures and/or field procedures require modification due to unexpected conditions. In general, the field team may identify the need for corrective action. The field staff, in conjunction with the field team leader, will recommend a corrective action. The Project Manager will approve the corrective measure, which will be implemented by the field team. It will be the responsibility of the Project Manager to ensure the corrective action has been implemented.

If the corrective action will supplement the WP or FSP, using existing and approved procedures in the QAPP, corrective action approved by the Project Manager will be documented. If corrective actions result in less samples, alternate sampling locations, etc., which may cause project QA objectives not to be achieved, it will be necessary that all levels of project management concur with the proposed action.

Corrective action resulting from internal field audits will be implemented immediately if data quality would be adversely affected due to unapproved or improper use of approved methods. The QA Manager will identify deficiencies and recommend corrective action to the Project Manager. Implementation of corrective actions will be performed by the field team under the direction of the Project Manager.

Corrective actions will be documented in the field notebook or field forms. No staff member will initiate corrective action without prior communication of findings through the proper channels. If the actions taken are insufficient to correct the problem identified, work may be stopped by the Project Manager. If at any time a corrective action issue is identified which directly impacts the project objectives, the Project Coordinator will be notified immediately.

5.9.2 Laboratory Corrective Action

Corrective actions in the laboratory may occur prior to, during or after initial analyses. As such, the initial analyses must be performed quickly enough to allow time for reanalysis within the required holding time. A number of conditions, such as broken sample containers, may be

identified during sample login or just prior to analysis. The Analytical Laboratory Project Manager will notify the QA Manager of such conditions prior to analysis. Following consultation with lab analysts and section leaders, it may be necessary for the Analytical Laboratory Project Manager to approve the implementation of corrective action. Some conditions that may trigger corrective action or optional procedures during or after analysis include dilution of samples, sample reanalysis when certain quality control criteria are not met, etc.

Laboratory personnel are alerted that corrective actions may be necessary if:

- QC data are outside the control limits for precision or accuracy;
- Sample results are outside the instrument calibration range;
- Laboratory method blanks contain target analytes above acceptable levels;
- Deficiencies are detected during internal or external audits or from the results of performance evaluation samples; or
- Inquiries concerning data quality are received.

The following specific instances require laboratory corrective action:

- The laboratory method blanks contain target analytes above the MQL and any associated sample contains the analyte at a concentration less than five times that in the blank.
- The LCS recovery is less than 10% for any organic target analyte or 30% for any inorganic analyte.
- The LCS recovery is outside the control limit for more than 1/2 of the target analytes for multi-analyte analyses such as PAHs.
- The surrogate recovery is less than 10% for any single surrogate.
- The MS recovery is less than 30% for any inorganic analyte.
- The internal standard area is less than 25% (i.e., -75%) of that in the midpoint standard for any single internal standard.

The corrective action shall include reanalyzing (and extracting or digesting, as applicable) the affected samples and/or immediate notification of the QA Manager.

Corrective action procedures are often handled at the bench level by the analyst, who reviews the analytical procedures for possible errors, checks the instrument calibrations and performance, etc. If the problem persists or cannot be identified, the matter is referred to the laboratory supervisor or Analytical Laboratory Project Manager for further investigation. Once resolved, full documentation of the corrective action procedure is filed. These corrective actions are performed prior to release of the data from the laboratory. All corrective actions associated with sample analyses for this project will be documented and reported in the sample package narrative.

5.9.3 Corrective Action During Data Validation and Data Assessment

The need for corrective action may be identified during either data validation or data assessment. Potential types of corrective action may include re-sampling, reanalysis of samples, or reprocessing of the sample data. These actions are dependent upon the ability to mobilize the field team and whether the data to be collected are necessary to meet the required QA objectives. If the QA Manager identifies a corrective action situation, it is the Project Manager who will be responsible for approving the implementation of corrective action. All corrective actions of this type will be documented by the QA Manager.

5.10 QUALITY CONTROL REPORTS

5.10.1 Laboratory Data Report

Laboratory data reports contain the results of all specified QC measures identified in Section 5.5, including but not limited to equipment blank, filter and reagent blanks, field blanks, laboratory duplicates, laboratory control standards, calibration, and matrix spikes. For chemical analyses, this is generally considered a Level III data report (see section 2.7.4 of RI/FS QAPP). This information is reviewed by the QA Manager and compared to the pre-specified acceptance criteria to determine acceptability of the data before forwarding to the Project Manager.

5.10.2 Reports to Project Management

The Field Supervisor will report to the Project Manager daily following each field monitoring event. A brief written report will be sent via e-mail to the Project Manager that documents any problems, delays, or corrective actions that may be required or that may affect the subsequent

sampling efforts. The report will also include a brief synopsis of the work conducted during the field monitoring event.

5.11 DECONTAMINATION PROCEDURES

Site personnel will perform decontamination in accordance with PBW SOP No.13: Equipment Decontamination, and the applicable SOPs for sampling sediments (RI/FS Field Sampling Plan, PBW, 2006b). Following sediment sample collection, the empty sampler should be rinsed and decontaminated using water and an Alconox® or an equivalent detergent, and rinsed with deionized water. The sampler and associated equipment is decontaminated before use and between sample sites. In addition, the sampler will be rinsed with Site water before samples are collected. Equipment used for sample collection, sub-sampling, and sample mixing will be stainless steel or Teflon®.

5.12 MANAGEMENT OF INVESTIGATION DERIVED WASTES

Due to the nature of the investigation, investigation derived wastes are not expected to be produced. If any wastes are generated they will be managed in accordance with the procedures described in the RI/FS FSP (PBW, 2006b) (Section 7.0).

6.0 HEALTH AND SAFETY PROCEDURES

The overall health and safety objective is to perform the field tasks in a manner that minimizes the potential for accidents or injuries, and minimizes the potential for worker exposure to hazardous chemicals. Details of the health and safety procedures are provided in the Site-Specific Health and Safety Plan (HSP) (PBW, 2005), dated August 17, 2005.

The HSP applies to the field activities described in this FSP that will be performed during the RI/FS at the Site. The HSP was prepared to comply with the requirements of 29 CFR 1910.120 (b)(4). The primary purpose of the plan is to provide the results of a hazard assessment conducted for the prescribed work tasks, and the health and safety requirements and protocols that will minimize hazards to site workers.

A copy of the HSP will be kept on site at all times during field activities. All personnel will complete the Safety Compliance Agreement provided in Appendix A of the HSP. Other health and safety documentation are detailed in the HSP.

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TABLES

TABLE 1
ASSESSMENT ENDPOINTS AND MEASURES

Guild	Receptor of Potential Concern	Assessment Endpoint for BERA	Ecological Risk Questions	Testable Hypotheses	Measures of Effects	Measures of Exposure	Measures of Ecosystem and Receptor Characteristics
Invertebrates	Earthworm	Protection of soil invertebrate community from uptake and direct toxic effects on detritivore abundance, diversity, productivity from COPECs in soil.	Does exposure to COPECs in soil adversely affect the abundance, diversity, productivity, and function?	Concentrations of COPECs in soil are adversely affecting invertebrate receptors.	Invertebrate receptor response to identified COPECs (4,4'-DDT, Aroclor-1254) in soils in the vicinity of sample location with HQs >1 (SB-204).	4,4'-DDT and Aroclor-1254 concentrations in soils in the vicinity of sample location SB-204 relative to appropriate effect levels.	Invertebrate receptor feeding behavior, growth and reproduction.
Benthos and zooplankton	Polychaetes	Protection of benthic and water-column invertebrate communities from uptake and direct toxic effects on abundance, diversity, and productivity from COPECs in sediment and surface water.	Does exposure to CPOECs in sediment and surface water adversely affect the abundance, diversity, productivity, and function?	Concetrations of COPECs in sediment and/or surface water are adversely affecting benthic receptors.	Benthic receptor response to identified COPECs in Intracoastal Waterway sediments and wetland sediments/surface water in the vicinity of sample locations with HQs >1 (multiple locations) or concentrations exceeding applicable surface water benchmarks.	COPEC concentrations in Intracoastal Waterway and wetland sediments in the vicinity of sample locations with HQs >1 (multiple locations) relative to appropriate effect levels.	Benthic receptor feeding behavior, growth and reproduction.

TABLE 2
ANALYTICAL METHODS

Media	COPECs	Test Method
Sediment		
Bulk Sediment	Toxicity (mortality, growth, reproduction)	US EPA 600/R-01/020 28d chronic *Leptocheirus plumulosus*
Bulk Sediment	Toxicity (growth)	US EPA 600/R-01/020 28d chronic *Neanthes arenaceodentata*
Bulk Sediment	Metals (nickel)	US EPA 6010B/6020
Bulk Sediment	Polynuclear Aromatic Hydrocarbons (PAHs) and hexachlorobenzene	US EPA 8270C
Bulk Sediment	Organochlorine Pesticides (4,4'-DDT, gamma chlordane, endrin aldehyde, endrin ketone)	US EPA 8081A
Bulk Sediment	Acid Volatile Sulfide/Simultaneously Extracted Metals (AVS/SEM) (nickel)	US EPA Draft Analytical Method EPA/821/R-91/100
Bulk Sediment	Total Organic Carbon (TOC)	US EPA 9060
Aqueous		
Pore Water, Surface Water	Metals (nickel, copper)	US EPA 6010B/6020
Pore Water	Polynuclear Aromatic Hydrocarbons (PAHs) and hexachlorobenzene	US EPA 8270C
Pore Water	Organochlorine Pesticides (4,4'-DDT, gamma-Chlordane, endrin aldehyde, endrin ketone)	US EPA 8081A
Surface Water	Toxicity (mortality, growth)	US EPA 821/R-02/014 7d chronic *Mysidopsis bahia*

Notes:
1. Bioassay tests will be performed by Aquatic Bioassay & Consulting Laboratories, Inc.
2. AVS/SEM analyses will be performed by TestAmerica Laboratories, Pittsburgh, PA.
3. PAH compounds are the PAHS included on the analyte list for EPA Method 8270C provided in the RI/FS QAPP (PBW, 2006c).

TABLE 3
SUMMARY OF SAMPLE LOCATIONS AND ANALYSES

Sample ID and Location	Selection Rationale	Sample Media	Analytical Method, Analytes, Organisms
Intracoastal Waterway Sediment			
EIWSED01 Intracoastal Waterway Sediment near RI/FS sample IWSE03	HQ>1 for 9 PAHs, LPAHs, HPAHs, and Total PAHs. Max HQ = 4 (acenapthene)	Sediment	***PAHs US EPA Method 8270*** PAHs (inclusive)
			Bioassay Amphipod - 28d Chronic, *Leptocheirus plumulosus* Polychaete - 28d Chronic, *Neanthes arenaceodentata*
			Total Organic Carbon
		Pore Water	***PAHs US EPA Method 8270*** PAHs (inclusive)
EIWSED02 Intracoastal Waterway Sediment near RI/FS sample IWSE01	4,4'-DDT HQ = 3	Sediment	***Organochlorine Pesticides US EPA Method 8081*** 4,4'-DDT
			Total Organic Carbon
			Bioassay Amphipod - 28d Chronic, *Leptocheirus plumulosus* Polychaete - 28d Chronic, *Neanthes arenaceodentata*
		Pore Water	***Organochlorine Pesticides US EPA Method 8081*** 4,4'-DDT
EIWSED03 Intracoastal Waterway Sediment near RI/FS sample IWSE07	HQ>1 for 4 PAHs and HPAHs, Max HQ = 5 (hexachlorobenzene)	Sediment	***PAHs & Hexachlorobenzene US EPA Method 8270*** PAHs (inclusive), hexachlorobenzene
			Total Organic Carbon
			Bioassay Amphipod - 28d Chronic, *Leptocheirus plumulosus* Polychaete - 28d Chronic, *Neanthes arenaceodentata*
		Pore Water	***PAHs & Hexachlorobenzene US EPA Method 8270*** PAHs (inclusive), hexachlorobenzene
EIWSED04 Intracoastal Waterway Reference Sediment Sample located in Intracoastal Waterway Background Area	No impacts above screening values were indicated in the vicinity of this location during RI sampling	Sediment	***PAHs & Hexachlorobenzene US EPA Method 8270*** PAHs (inclusive), hexachlorobenzene
			Organochlorine Pesticides US EPA Method 8081 4,4'-DDT
			Total Organic Carbon
			Bioassay Amphipod - 28d Chronic, *Leptocheirus plumulosus* Polychaete - 28d Chronic, *Neanthes arenaceodentata*
		Pore Water	***PAHs & Hexachlorobenzene US EPA Method 8270*** PAHs (inclusive), hexachlorobenzene
			Organochlorine Pesticides US EPA Method 8081 4,4'-DDT
EIWSED05 Intracoastal Waterway Reference Sediment Sample located in Intracoastal Waterway Background Area	No impacts above screening values were indicated in the vicinity of this location during RI sampling	Sediment	***PAHs US EPA Method 8270*** PAHs (inclusive), hexachlorobenzene
			Organochlorine Pesticides US EPA Method 8081 4,4'-DDT
			Total Organic Carbon
			Bioassay Amphipod - 28d Chronic, *Leptocheirus plumulosus* Polychaete - 28d Chronic, *Neanthes arenaceodentata*
		Pore Water	***PAHs US EPA Method 8270*** PAHs (inclusive), hexachlorobenzene
			Organochlorine Pesticides US EPA Method 8081 4,4'-DDT

TABLE 3
SUMMARY OF SAMPLE LOCATIONS AND ANALYSES

Sample ID and Location	Selection Rationale	Sample Media	Analytical Method, Analytes, Organisms
Wetland Sediment			
EWSED01 North Area located near RI/FS sample NA4SE04	HQ>1 for HPAHs and 4,4'-DDT, Max HQ = 4 (4,4'-DDT)	Sediment	***PAHs US EPA Method 8270*** PAHs (inclusive)
			Organochlorine Pesticides US EPA Method 8081 4,4'-DDT
			Total Organic Carbon
			Bioassay Amphipod - 28d Chronic, *Leptocheirus plumulosus* Polychaete - 28d Chronic, *Neanthes arenaceodentata*
		Pore Water	***PAHs US EPA Method 8270*** PAHs (inclusive)
			Organochlorine Pesticides US EPA Method 8081 4,4'-DDT
EWSED02 North Area located near RI/FS sample NB4SE08	HQ>1 for 12 PAHs, LPAHs, HPAHs, and Total PAHs, 4,4'-DDT, and Endrin aldehyde, Max HQ = 8 (4,4'-DDT)	Sediment	***PAHs US EPA Method 8270*** PAHs (inclusive)
			Organochlorine Pesticides US EPA Method 8081 4,4'-DDT, Endrin aldehyde
			Total Organic Carbon
			Bioassay Amphipod - 28d Chronic, *Leptocheirus plumulosus* Polychaete - 28d Chronic, *Neanthes arenaceodentata*
		Pore Water	***PAHs US EPA Method 8270*** PAHs (inclusive)
			Organochlorine Pesticides US EPA Method 8081 4,4'-DDT, Endrin aldehyde
EWSED03 North Area located near RI/FS sample NC4SE12	HQ>1 for HPAHs and 4,4'-DDT, Max HQ = 4 (4,4'-DDT)	Sediment	***PAHs US EPA Method 8270*** PAHs (inclusive)
			Organochlorine Pesticides US EPA Method 8081 4,4'-DDT
			Total Organic Carbon
			Bioassay Amphipod - 28d Chronic, *Leptocheirus plumulosus* Polychaete - 28d Chronic, *Neanthes arenaceodentata*
		Pore Water	***PAHs US EPA Method 8270*** PAHs (inclusive)
			Organochlorine Pesticides US EPA Method 8081 4,4'-DDT
EWSED04 North Area located near RI/FS sample NB2SE06	HQ>1 for 3 PAHs and LPAHs, Max HQ = 6 (2-Methylnaphthalene)	Sediment	***PAHs US EPA Method 8270*** PAHs (inclusive)
			Total Organic Carbon
			Bioassay Amphipod - 28d Chronic, *Leptocheirus plumulosus* Polychaete - 28d Chronic, *Neanthes arenaceodentata*
		Pore Water	***PAHs US EPA Method 8270*** PAHs (inclusive)
EWSED05 Off-site north of North Area located near RI/FS sample 2WSED4	HQ>1 for 8 PAHs, LPAHs, HPAHs, Total PAHs, nickel, endrin aldehyde, endrin ketone, and gamma-Chlordane, Max HQ= 46 (dibenz(a,h)anthracene)	Sediment	***PAHs US EPA Method 8270*** PAHs (inclusive)
			Organochlorine Pesticides US EPA Method 8081 Endrin aldehyde, endrin ketone, gamma-Chlordane
			Metals US EPA Method 6010/6020 Nickel
			Acid Volatile Sulfide/Simultaneously Extracted Metals (nickel)
			Total Organic Carbon
			Bioassay Amphipod - 28d Chronic, *Leptocheirus plumulosus* Polychaete - 28d Chronic, *Neanthes arenaceodentata*
		Pore Water	***PAHs US EPA Method 8270*** PAHs (inclusive)
			Organochlorine Pesticides US EPA Method 8081 Endrin aldehyde, endrin ketone, gamma-Chlordane
			Metals US EPA Method 6010/6020 Nickel
EWSED06 Off-site north of North Area located near RI/FS sample 2WSED3	HQ>1 for 8 PAHs, LPAHs, HPAHs, Total PAHs, endrin aldehyde, and endrin ketone, Max HQ= 45 (dibenz(a,h)anthracene)	Sediment	***PAHs US EPA Method 8270*** PAHs (inclusive)
			Organochlorine Pesticides US EPA Method 8081 Endrin aldehyde, endrin ketone
			Total Organic Carbon
			Bioassay Amphipod - 28d Chronic, *Leptocheirus plumulosus* Polychaete - 28d Chronic, *Neanthes arenaceodentata*
		Pore Water	***PAHs US EPA Method 8270*** PAHs (inclusive)
			Organochlorine Pesticides US EPA Method 8081 Endrin aldehyde, endrin ketone

TABLE 3
SUMMARY OF SAMPLE LOCATIONS AND ANALYSES

Sample ID and Location	Selection Rationale	Sample Media	Analytical Method, Analytes, Organisms
Wetland Sediment Continued			
EWSED07 Off-site north of North Area near RI/FS sample 2WSED5 and 2WSED6	HQ>1 for 4 PAHs, HPAHs, Total PAHs, endrin aldehyde, and endrin ketone, Max HQ = 29 (dibenzo(a,h)anthracene	Sediment	***PAHs US EPA Method 8270*** PAHs (inclusive)
			Organochlorine Pesticides US EPA Method 8081 Endrin aldehyde, endrin ketone
			Total Organic Carbon
			Bioassay Amphipod - 28d Chronic, *Leptocheirus plumulosus* Polychaete - 28d Chronic, *Neanthes arenaceodentata*
		Pore Water	***PAHs US EPA Method 8270*** PAHs (inclusive)
			Organochlorine Pesticides US EPA Method 8081 Endrin aldehyde, endrin ketone
EWSED08 North Area reference sample off-site to the northwest of North Area, in the vicinity of RI/FS sample 3WSED6	No impacts above screening values were indicated in the vicinity of this location during RI sampling	Sediment	***PAHs US EPA Method 8270*** PAHs (inclusive)
			Organochlorine Pesticides US EPA Method 8081 4,4'-DDT, Endrin aldehyde, endrin ketone, gamma-Chlordane
			Metals US EPA Method 6010/6020 Nickel
			Acid Volatile Sulfide/Simultaneously Extracted Metals (nickel)
			Total Organic Carbon
			Bioassay Amphipod - 28d Chronic, *Leptocheirus plumulosus* Polychaete - 28d Chronic, *Neanthes arenaceodentata*
		Pore Water	***PAHs US EPA Method 8270*** PAHs (inclusive)
			Organochlorine Pesticides US EPA Method 8081 4,4'-DDT, Endrin aldehyde, endrin ketone, gamma-Chlordane
			Metals US EPA Method 6010/6020 Nickel
EWSED09 North Area reference sample off-site to the northwest of North Area, in the vicinity of RI/FS sample 2WSED11	No impacts above screening values were indicated in the vicinity of this location during RI sampling	Sediment	***PAHs US EPA Method 8270*** PAHs (inclusive)
			Organochlorine Pesticides US EPA Method 8081 4,4'-DDT, Endrin aldehyde, endrin ketone, gamma-Chlordane
			Metals US EPA Method 6010/6020 Nickel
			Acid Volatile Sulfide/Simultaneously Extracted Metals (nickel)
			Total Organic Carbon
			Bioassay Amphipod - 28d Chronic, *Leptocheirus plumulosus* Polychaete - 28d Chronic, *Neanthes arenaceodentata*
		Pore Water	***PAHs US EPA Method 8270*** PAHs (inclusive)
			Organochlorine Pesticides US EPA Method 8081 4,4'-DDT, Endrin aldehyde, endrin ketone, gamma-Chlordane
			Metals US EPA Method 6010/6020 Nickel
Surface Water			
EWSW01 Surface water location off-site north of the North Area near RI/FS sample location 2WSW1	Dissolved copper concentration exceeds ecological benchmark for water	Surface Water	***Metals US EPA 6010/6020*** Dissolved copper
			Bioassay 7d Chronic (growth and survival), *Mysidopsis bahia*
EWSW02 Surface water reference sample location off-site north of the North Area west of RI/FS surface water sample locations	No impacts above screening values were indicated in the vicinity of this location during RI	Surface Water	***Metals US EPA 6010/6020*** Dissolved copper
			Bioassay 7d Chronic (growth and survival), *Mysidopsis bahia*

Notes:
1. Sample locations are provided on Figures 5 through 9.
2. HQs are based on ERL values except for hexachlorobenzene which is based on an ACT.
3. PAH compounds are the PAH compounds included in the analyte list for EPA Method 8270C provided in the RI/FS QAPP (PBW, 2006c).

TABLE 4
MEASUREMENT QUALITY OBJECTIVES

Parameter	Accuracy	Precision	Completeness Goal
Bulk Sediment Analyses			
Organics	40%	40%	90%
Inorganics	30%	30%	90%
Sediment Toxicity	NA	NA	90%
Total Organic Carbon	30%	30%	90%
Acid Volatile Sulfide	30%	30%	90%
Sediment Pore Water Analyses			
Organics	40%	40%	90%
Inorganics	30%	30%	90%
Surface Water Analyses			
Inorganics	30%	30%	90%
Aqueous Toxicity	NA	NA	90%

Notes:

1. Accuracy requirements are expressed as the maximum allowable percent deviation (%) from the true value.
2. Precision requirements are expressed as maximum allowable relative percent differenc (RPD) between two or more replicate measurements.
3. Completeness goals are the percentage of samples for which results are expected to be obtained successfully.
4. Data quality objectives including accuracy and precision for bioassay toxicity tests are discussed in the applicable test methodology guidance.
5. For chemical analyses, data quality objectives for specific analytes are provided in the Appendices C and D of the RI/FS QAPP.

TABLE 5
SUMMARY OF SAMPLE CONTAINERS, PRESERVATIVES, AND HOLD TIMES

Parameter	Sample Container and Preservative		Sample Storage	Maximum Holding Time
	Aqueous	Sediment		
Metals	250 ml glass or HDPE bottle, HNO3	4 oz glass or plastic	4±2° C	6 months
PAHs	2x1000 ml amber glass	4 oz glass or plastic	4±2° C	7 days water, 14 days soil (preparation); 40 days (analysis)
Organochlorine Pesticides	2x1000 ml amber glass	4 oz glass or plastic	4±2° C	7 days water, 14 days soil (preparation); 40 days (analysis)
TOC	NA	250 ml plastic	4±2° C	28 days
AVS/SEM	NA	100 grams glass or plastic	4±2° C	14 days
Bioassay	1 gallon plastic	1L plastic	4±2° C	8 weeks
Moisture	NA	4 oz glass jar	4±2° C	NA

Notes:

1. NA = Not applicable to this analysis or matrix.
2. Sample volumes submitted for analysis of pore water may be reduced due to limited sample volume.

FIGURES

TEXAS

QUADRANGLE LOCATION

N

Scale in Feet

0 1000 2000

Source:
Base map taken from http://www.tnris.state.tx.us Freeport, Texas 7.5 min. U.S.G.S. quadrangle, 1974.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 1

SITE LOCATION MAP

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: MARCH, 2010	CHECKED: EFP	

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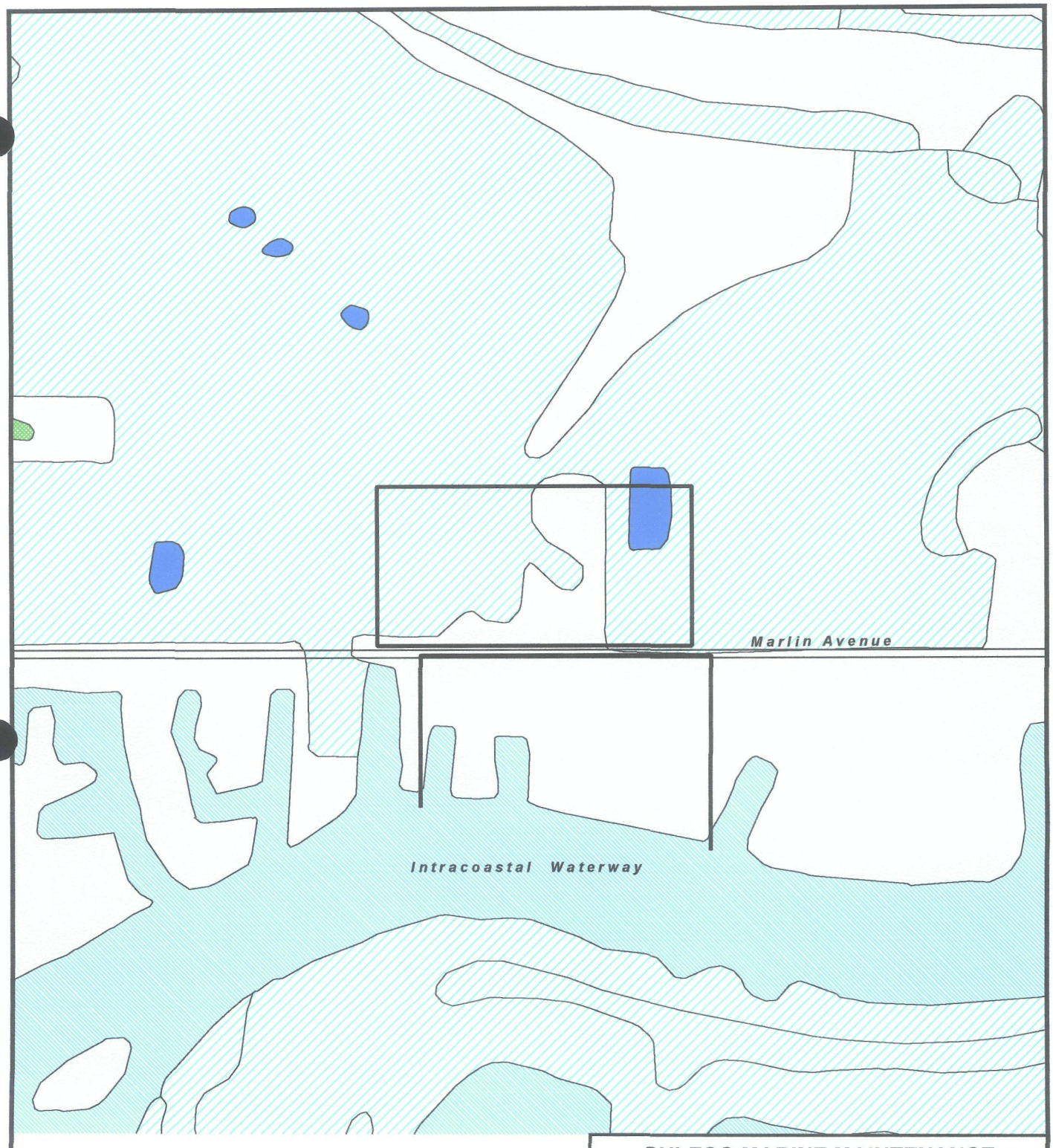

EXPLANATION

- Approx. Site Boundary
- Upland Area
- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Pond

N

Approx. Scale in Feet

0 300 600

Source:
U.S. Fish & Wildlife Service, Wetlands Online Mapper, 2008.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 2

WETLAND MAP

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: MARCH, 2010	CHECKED: EFP	

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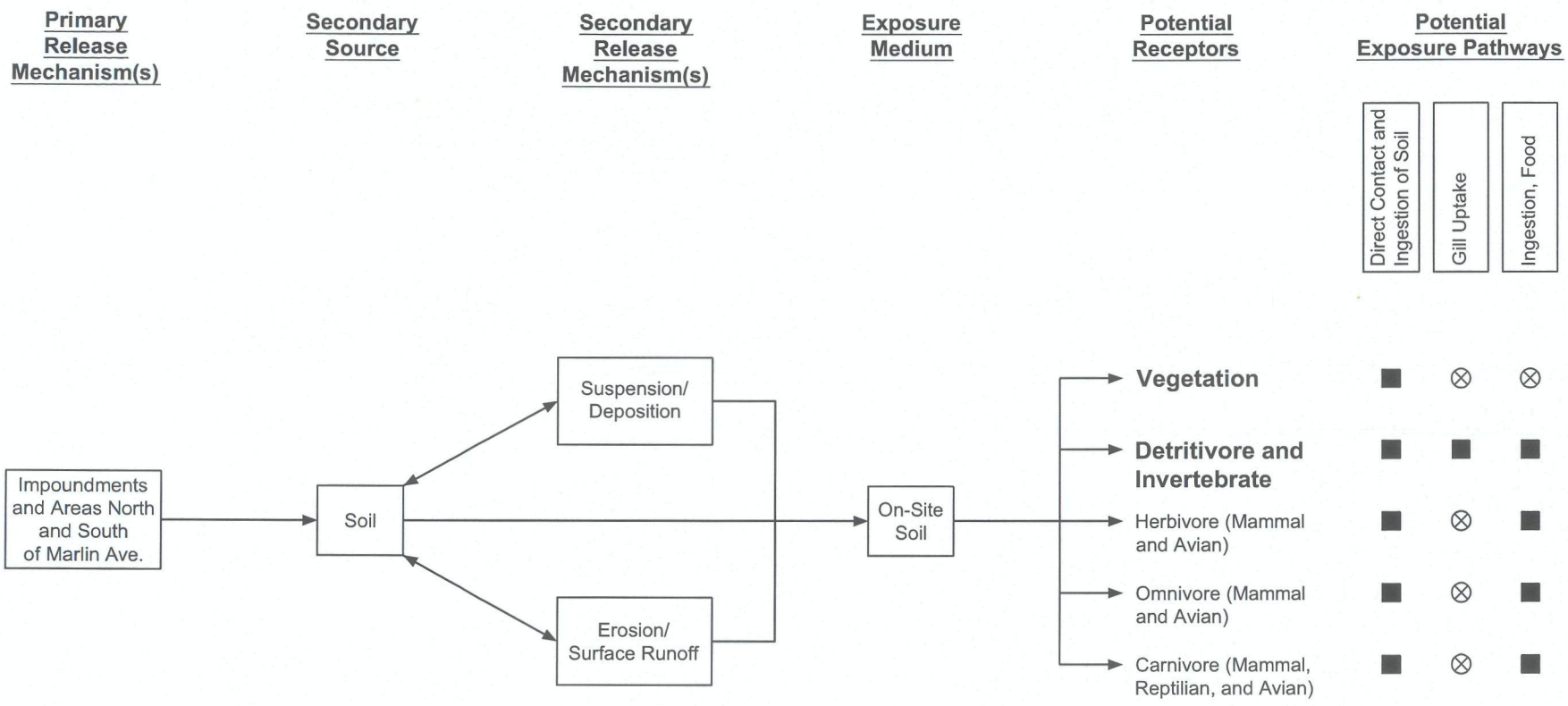

LEGEND

- ■ Pathway is potentially complete
- ⊠ Pathway is incomplete
- ⊗ Pathway is not viable

Note:
Significant Potential Receptors shown in bold.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 3

TERRESTRIAL ECOSYSTEM CONCEPTUAL SITE MODEL

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: MARCH, 2010	CHECKED: KHT	

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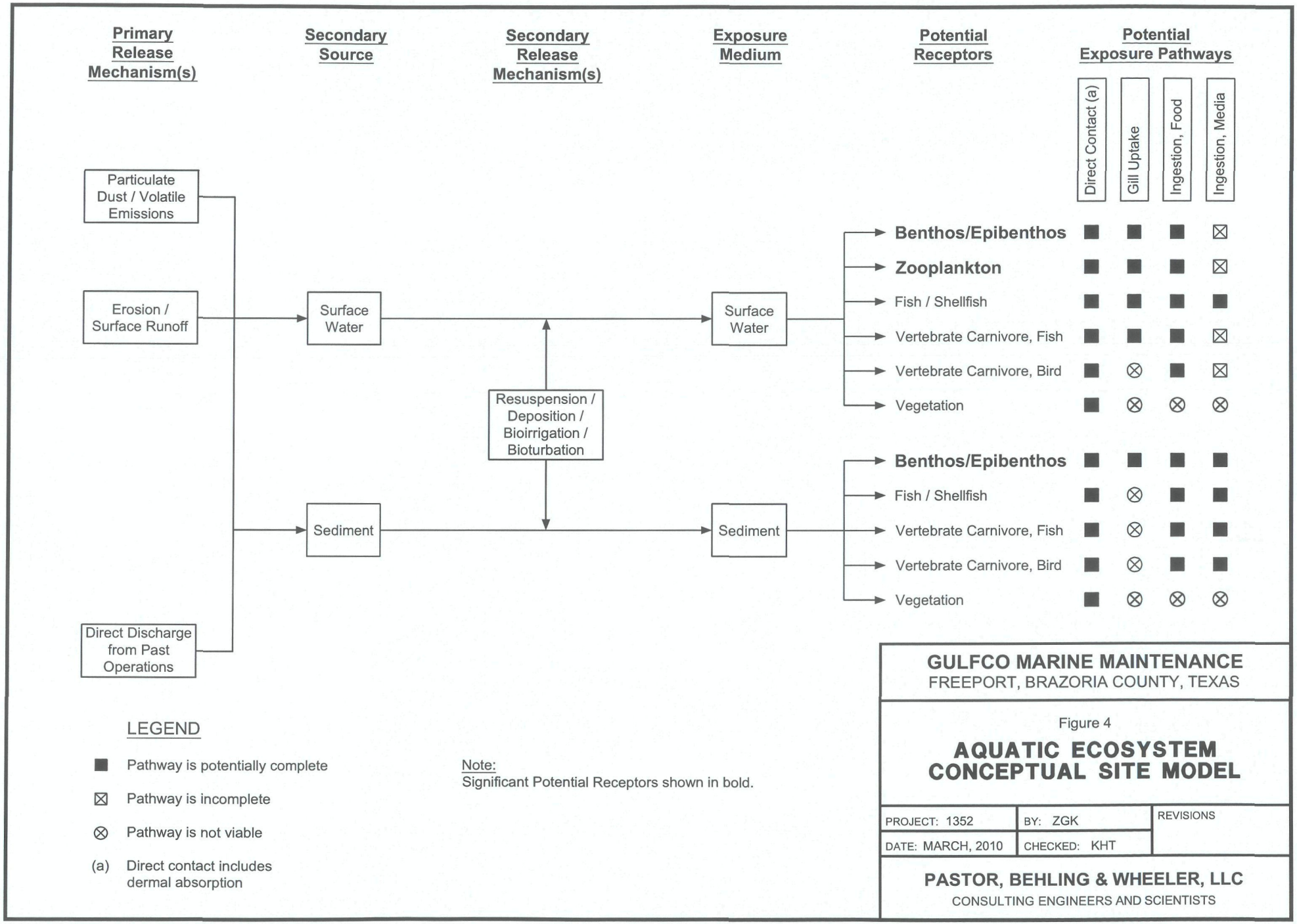
Primary Release Mechanism(s)
Secondary Source
Secondary Release Mechanism(s)
Exposure Medium
Potential Receptors
Potential Exposure Pathways
Direct Contact (a)
Gill Uptake
Ingestion, Food
Ingestion, Media
Particulate Dust / Volatile Emissions
Erosion / Surface Runoff
Direct Discharge from Past Operations
Surface Water
Sediment
Resuspension / Deposition / Bioirrigation / Bioturbation
Surface Water
Sediment
Benthos/Epibenthos
Zooplankton
Fish / Shellfish
Vertebrate Carnivore, Fish
Vertebrate Carnivore, Bird
Vegetation
Benthos/Epibenthos
Fish / Shellfish
Vertebrate Carnivore, Fish
Vertebrate Carnivore, Bird
Vegetation
LEGEND
■ Pathway is potentially complete
⊠ Pathway is incomplete
⊗ Pathway is not viable
(a) Direct contact includes dermal absorption
Note:
Significant Potential Receptors shown in bold.
GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS
Figure 4
AQUATIC ECOSYSTEM CONCEPTUAL SITE MODEL
PROJECT: 1352
BY: ZGK
REVISIONS
DATE: MARCH, 2010
CHECKED: KHT
PASTOR, BEHLING & WHEELER, LLC
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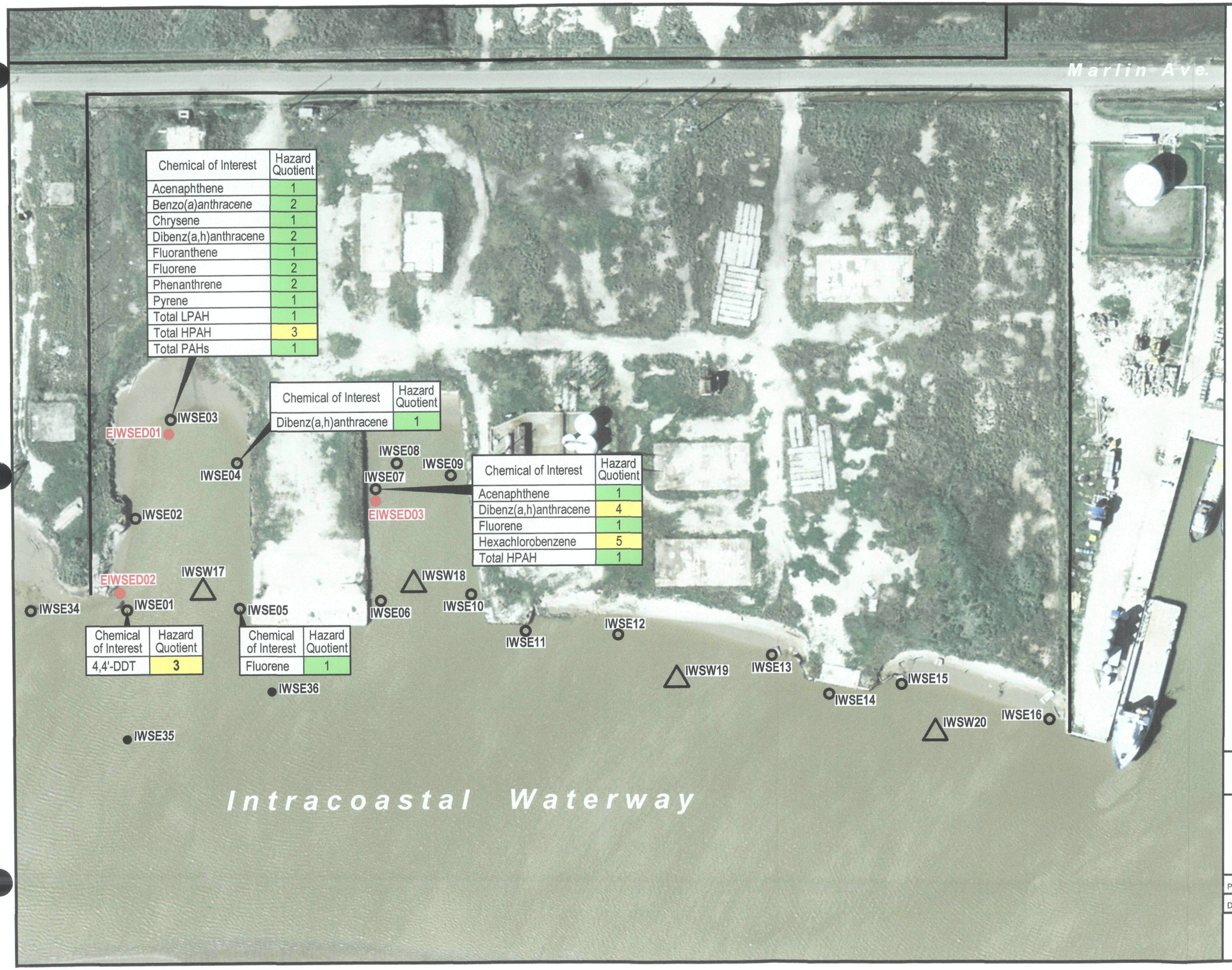

EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- RI/FS Intracoastal Waterway Sediment Sample
- RI/FS Intracoastal Waterway Surface Water Sample
- RI/FS Attempted Intracoastal Waterway Sediment Sample (not enough sediment present to allow for sampling)
- Proposed Sediment Sample Location

Notes:

1. For sample concentration data, see SLERA Figure 9.
2. All Hazard Quotients for other receptors or compounds of concern were less than one. HQs for benthic receptors were based on the Effects Range Low except hexachlorobenzene which were based on the Apparent Effects Threshold.

Hazard Quotients:

- > 1 and ⩽ 2
- > 2 and ⩽ 5
- > 5 but ⩽ 10
- > 10

Approx. Scale in Feet

0 60 120

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 5

PROPOSED SAMPLE LOCATIONS INTRACOASTAL WATERWAY

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: MARCH, 2010	CHECKED: KHT	

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EXPLANATION

- RI/FS Sediment Station
- RI/FS Surface Water Station
- Proposed Sediment Reference Sample Location

N

Approx. Scale in Feet

0 125 250

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 6

PROPOSED SAMPLE LOCATIONS INTRACOASTAL WATERWAY REFERENCE SAMPLES

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: MARCH, 2010	CHECKED: KHT	

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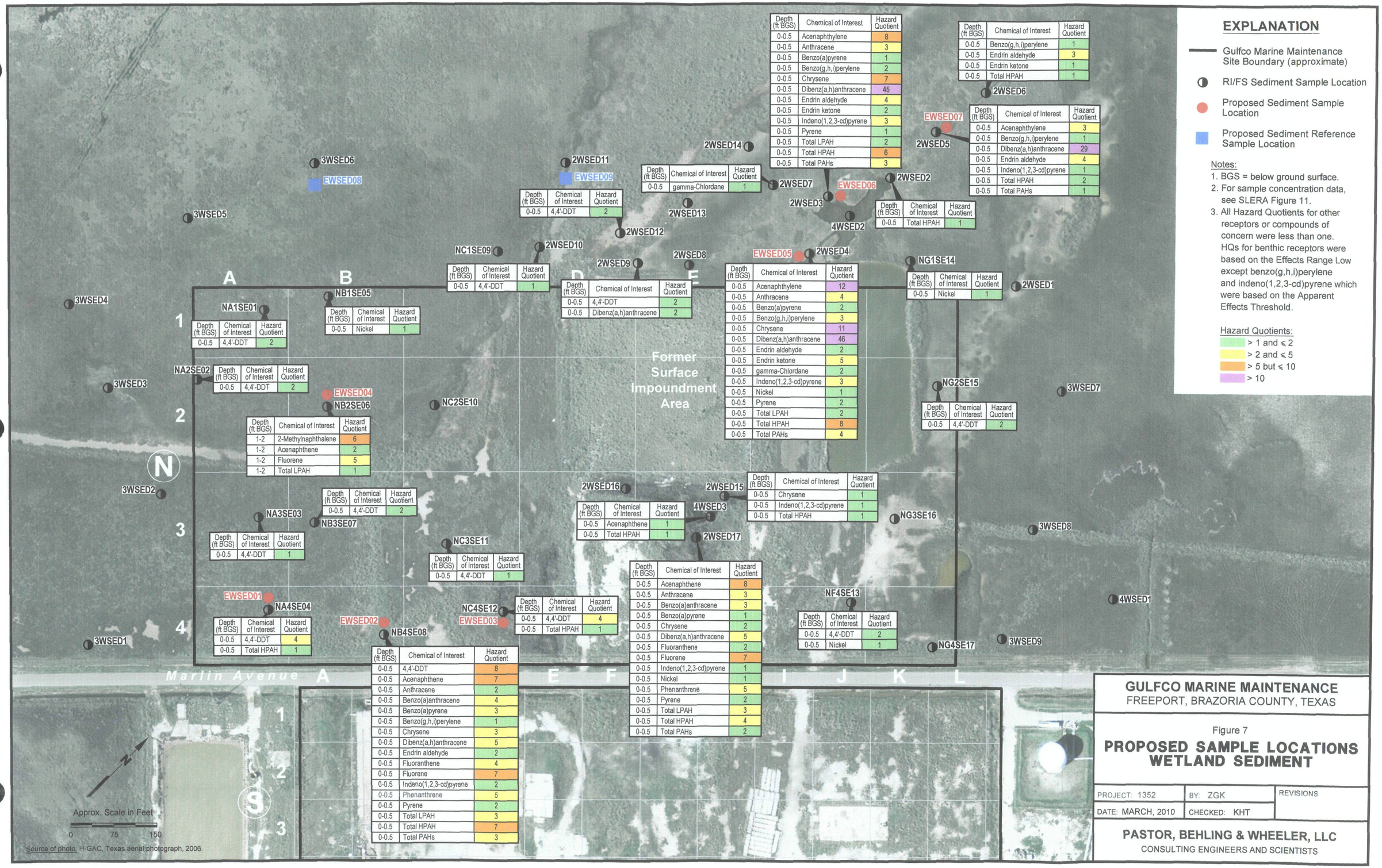


Depth (ft BGS)	Chemical of Interest	Hazard Quotient
0-0.5	4,4'-DDT	2

Depth (ft BGS)	Chemical of Interest	Hazard Quotient
0-0.5	Nickel	1

Depth (ft BGS)	Chemical of Interest	Hazard Quotient
0-0.5	4,4'-DDT	1

Depth (ft BGS)	Chemical of Interest	Hazard Quotient
0-0.5	4,4'-DDT	2
0-0.5	Dibenz(a,h)anthracene	2

Depth (ft BGS)	Chemical of Interest	Hazard Quotient
0-0.5	Acenaphthylene	12
0-0.5	Anthracene	4
0-0.5	Benzo(a)pyrene	2
0-0.5	Benzo(g,h,i)perylene	3
0-0.5	Chrysene	11
0-0.5	Dibenz(a,h)anthracene	46
0-0.5	Endrin aldehyde	2
0-0.5	Endrin ketone	5
0-0.5	gamma-Chlordane	2
0-0.5	Indeno(1,2,3-cd)pyrene	3
0-0.5	Nickel	1
0-0.5	Pyrene	2
0-0.5	Total LPAH	2
0-0.5	Total HPAH	8
0-0.5	Total PAHs	4

Depth (ft BGS)	Chemical of Interest	Hazard Quotient
0-0.5	Nickel	1

Depth (ft BGS)	Chemical of Interest	Hazard Quotient
0-0.5	4,4'-DDT	2

Depth (ft BGS)	Chemical of Interest	Hazard Quotient
1-2	2-Methylnaphthalene	6
1-2	Acenaphthene	2
1-2	Fluorene	5
1-2	Total LPAH	1

Depth (ft BGS)	Chemical of Interest	Hazard Quotient
0-0.5	4,4'-DDT	2

Depth (ft BGS)	Chemical of Interest	Hazard Quotient
0-0.5	4,4'-DDT	1

Depth (ft BGS)	Chemical of Interest	Hazard Quotient
0-0.5	Acenaphthene	1
0-0.5	Total HPAH	1

Depth (ft BGS)	Chemical of Interest	Hazard Quotient
0-0.5	Chrysene	1
0-0.5	Indeno(1,2,3-cd)pyrene	1
0-0.5	Total HPAH	1

Depth (ft BGS)	Chemical of Interest	Hazard Quotient
0-0.5	Acenaphthene	8
0-0.5	Anthracene	3
0-0.5	Benzo(a)anthracene	3
0-0.5	Benzo(a)pyrene	1
0-0.5	Chrysene	2
0-0.5	Dibenz(a,h)anthracene	5
0-0.5	Fluoranthene	2
0-0.5	Fluorene	7
0-0.5	Indeno(1,2,3-cd)pyrene	1
0-0.5	Nickel	1
0-0.5	Phenanthrene	5
0-0.5	Pyrene	2
0-0.5	Total LPAH	3
0-0.5	Total HPAH	4
0-0.5	Total PAHs	2

Depth (ft BGS)	Chemical of Interest	Hazard Quotient
0-0.5	4,4'-DDT	4
0-0.5	Total HPAH	1

Depth (ft BGS)	Chemical of Interest	Hazard Quotient
0-0.5	4,4'-DDT	8
0-0.5	Acenaphthene	7
0-0.5	Anthracene	2
0-0.5	Benzo(a)anthracene	4
0-0.5	Benzo(a)pyrene	3
0-0.5	Benzo(g,h,i)perylene	1
0-0.5	Chrysene	3
0-0.5	Dibenz(a,h)anthracene	5
0-0.5	Endrin aldehyde	2
0-0.5	Fluoranthene	4
0-0.5	Fluorene	7
0-0.5	Indeno(1,2,3-cd)pyrene	2
0-0.5	Phenanthrene	5
0-0.5	Pyrene	2
0-0.5	Total LPAH	3
0-0.5	Total HPAH	7
0-0.5	Total PAHs	3

Depth (ft BGS)	Chemical of Interest	Hazard Quotient
0-0.5	Acenaphthylene	8
0-0.5	Anthracene	3
0-0.5	Benzo(a)pyrene	1
0-0.5	Benzo(g,h,i)perylene	2
0-0.5	Chrysene	7
0-0.5	Dibenz(a,h)anthracene	45
0-0.5	Endrin aldehyde	4
0-0.5	Endrin ketone	2
0-0.5	Indeno(1,2,3-cd)pyrene	3
0-0.5	Pyrene	1
0-0.5	Total LPAH	2
0-0.5	Total HPAH	6
0-0.5	Total PAHs	3

Depth (ft BGS)	Chemical of Interest	Hazard Quotient
0-0.5	Benzo(g,h,i)perylene	1
0-0.5	Endrin aldehyde	3
0-0.5	Endrin ketone	1
0-0.5	Total HPAH	1

Depth (ft BGS)	Chemical of Interest	Hazard Quotient
0-0.5	Acenaphthylene	3
0-0.5	Benzo(g,h,i)perylene	1
0-0.5	Dibenz(a,h)anthracene	29
0-0.5	Endrin aldehyde	4
0-0.5	Indeno(1,2,3-cd)pyrene	1
0-0.5	Total HPAH	2
0-0.5	Total PAHs	1

Depth (ft BGS)	Chemical of Interest	Hazard Quotient
0-0.5	Total HPAH	1

EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- RI/FS Sediment Sample Location
- Proposed Sediment Sample Location
- Proposed Sediment Reference Sample Location

Notes:

1. BGS = below ground surface.
2. For sample concentration data, see SLERA Figure 11.
3. All Hazard Quotients for other receptors or compounds of concern were less than one. HQs for benthic receptors were based on the Effects Range Low except benzo(g,h,i)perylene and indeno(1,2,3-cd)pyrene which were based on the Apparent Effects Threshold.

Hazard Quotients:

- > 1 and ≤ 2
- > 2 and ≤ 5
- > 5 but ≤ 10
- > 10

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 7

PROPOSED SAMPLE LOCATIONS WETLAND SEDIMENT

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: MARCH, 2010	CHECKED: KHT	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- RI/FS Wetland Surface Water Sample Location
- Proposed Surface Water Sample Location
- Proposed Surface Water Reference Sample Location

Notes:
1. *Data Qualifier: J = Estimated value.*
2. Bolded values are the maximum measured concentration for that compound.
3. Values shown in the figure exceed the Texas Surface Water Quality Standard.
4. Sample locations are subject to the presence of surface water at the time of sampling.

N

Approx. Scale in Feet

0 60 120

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 8

PROPOSED SAMPLE LOCATIONS WETLAND SURFACE WATER

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: MARCH, 2010	CHECKED: KHT	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

APPENDICES

APPENDIX A

STANDARD OPERATING PROCEDURES

LIST OF STANDARD OPERATING PROCEDURES

SOP Number	Source	Title	Revision No. and Date
NA	Aquatic Bioassay & Consulting Laboratories, Inc.	STANDARD OPERATING PROCEDURES FOR THE 28 DAY SEDIMENT SURVIVAL, GROWTH, & REPRODUCTION BIOASSAY WITH *Leptocheirus plumulosus* EPA 600/R-01/020 (March 2001)	3/8/2010
NA	Aquatic Bioassay & Consulting Laboratories, Inc.	STANDARD OPERATING PROCEDURES FOR CHRONIC MYSID SHRIMP TOXICITY TEST	11/3/2006
NA	Aquatic Bioassay & Consulting Laboratories, Inc.	STANDARD OPERATING PROCEDURES FOR THE 28 DAY SEDIMENT SURVIVAL & GROWTH, BIOASSAY WITH *Neanthes arenaceodentata* (Army Corps of Engineers, Inland Testing Manual)	3/10/2010
20	PBW	STANDARD OPERATING PROCEDURE No. 20a FOR DATA VALIDATION OF TOXICITY TESTS	12/26/2002

STANDARD OPERATING PROCEDURE

STANDARD OPERATING PROCEDURES FOR THE 28 DAY SEDIMENT SURVIVAL, GROWTH, & REPRODUCTION BIOASSAY WITH *Leptocheirus plumulosus* EPA 600/R-01/020 (March 2001)

Prepared By:

Aquatic Bioassay & Consulting Laboratories, Inc.

March 8, 2010

STANDARD OPERATING PROCEDURES FOR THE 28 DAY SEDIMENT SURVIVAL, GROWTH, & REPRODUCTION BIOASSAY WITH *Leptocheirus plumulosus* EPA 600/R-01/020 (March 2001)

ENDPOINT DESCRIPTION

<24 hour old *Leptocheirus plumulosus* are exposed in a static renewal system to test solutions of sediment and control water for 28 days. The endpoints are survival, growth, (increase in weight) and reproduction of *Leptocheirus* compared to controls.

SAMPLE COLLECTION

Samples are collected and placed into 1 liter high density polyethylene (HDPE) containers. Samples can be stored for up to eight weeks in the dark at 4°C.

TEST ORGANISMS

Leptocheirus plumulosus are supplied by Aquatic Biosystems Inc. in Fort Collins, Colorado. The test organisms must be <24 hours in age and within 1-2 hour range in age. Organism cultures are acclimated for a period greater than 96 hours and less than 14 days to reach target salinity.

OVERLYING WATER

Three types of water may be used as overlying water: 1) Receiving water - seawater collected from areas around the vicinity of outfall, 2) Natural, l-um filtered, UV sterilized salt water from University of California at Santa Barbara, 3) Reconstituted sea salts using "Tropic Marin" brand sea salts and purified D.I. water.

SEDIMENT PREPARATION

The day before the sediment test is started (Day -1) each sediment is thoroughly homogenized by passing it through a sifting screen. 175mL of the sediment is then added to the chambers. 725mL of overlying water is then added to each of the test chambers. Suspension of the sediment can be avoided by carefully pouring the water down the side of the test chamber. Chemical analysis should be taken on the initial (Day 0) and (Day

28) of the test including: pH, temperature, dissolved oxygen, salinity, and ammonia. All other dates require monitoring of the temperature and dissolved oxygen.

REFERENCE TOXICANT CONCENTRATIONS

Reference toxicants are mixed from a stock copper solution of 10.0mg/L supplied by Environmental Resource Associates. The reference toxicants are mixed in concentrations of: 20, 40, 80, 120, 160, and 200µg/L.

RENEWAL OF OVERLYING WATER

Renewal of overlying water is achieved by intermittent volume additions of 400mL every other day. Water is changed out every other day of testing. Test containers are maintained at 25°C with a variation of ±3°C.

PLACING ORGANISMS IN TEST CHAMBERS

<24 hour old *Leptocheirus plumulosus* are pipetted directly into test chambers. 20 organisms are used per chamber. 5 replicates are used per treatment.

FEEDING

Feeding occurs three times per week (M-W-F) after overlying water renewal. For each test chamber 20mg of TetraMin is added on days 1-13 and 40mg on days 14-28.

MONITORING A TEST

All chambers are checked daily and observations are made to assess organism behavior such as sediment avoidance. Overlying water is monitored with daily measurement of dissolved oxygen, salinity, and temperature. Ammonia and pH are checked at the beginning and end of the test.

ENDING A TEST

The final water quality analyses are taken in the test chambers. The sediment in each of the test chambers is poured through a sieve to isolate the test organisms. Mobile organisms are counted as alive. Survival information is logged on a tracking sheet for the test. Surviving organisms are placed in pre prepared weigh boats to calculate growth. If offspring are observed they are counted.

TEST DATA ANALYSIS

Survival and growth are measured at the end of the 28-d sediment toxicity test with *Leptocheirus plumulosus.* Survival endpoints are reported as the percent of surviving organisms in the treatment. Growth is often a more sensitive toxicity endpoint. Dry weight of *Leptocheirus* is determined by pooling all living organisms from a replicate and drying the sample at 60°C- 90°C to a constant weight. The sample is brought to room temperature in a desiccator and weighed to the nearest 0.01mg to obtain mean weight per surviving organism. Offspring are enumerated as number of offspring as a percent/control factor.

REFERENCES

US EPA. Method for Assessing the Chronic Toxicity of Marine and Estuarine Sediment-associated Contaminants with the Amphipod *Leptocheirus plumulosus*. (First Edition). March 2001.

Revised 3/8/2010

STANDARD OPERATING PROCEDURE

STANDARD OPERATING PROCEDURES FOR CHRONIC MYSID SHRIMP TOXICITY TEST

Prepared By:

Aquatic Bioassay & Consulting Laboratories, Inc.

November 3, 2006

STANDARD OPERATING PROCEDURES FOR CHRONIC MYSID SHRIMP TOXICITY TEST

ENDPOINT DESCRIPTION

Seven day old mysid shrimps (*Mysidopsis bahia*) are exposed in a static renewal system to various test solutions for seven days. The endpoints are survival, growth, and egg development.

DILUTION WATER

Three types of water may be used as a dilution source: 1) receiving water: seawater collected from areas around the vicinity of outfall. 2) Natural, 1 um filtered, UV sterilized salt water from the University of California at Santa Barbara. 3) Reconstituted sea salts using "Tropic Marin" brand sea salts and highly purified D.I. water.

All reference toxicant tests use the same water source each time a test is conducted. The holding and testing temperature for this test is 26± 1 deg C.

EFFLUENT CONCENTRATIONS

Test solutions are prepared on the day of initiation and every 24 hours for seven days. Five concentrations, a reference control, and a brine control (each with eight replicate test chambers) are used.

Test chambers are 8 oz plastic disposable cups containing 150 ml of test solution. Larvae are contained within 200 micron Nytex screens cemented around a petri dish with silicone sealant. Each cylinder fits inside the beaker, the liquid is poured in and the mysids are added. All beakers are labeled prior to preparation.

Glassware cleaning Procedure:

1. Wash in warm, soapy water.
2. Rinse with tap water.
3. Rinse with reagent grade acetone.
4. Rinse with D.I. water.
5. Soak in 3N HCL for 24 hours.
6. Rinse with D.I. water.
7. Rinse with 2N HNO3.
8. Rinse with D.I. water.
9. Soak in D.I. water for 24 hours.
10. Rinse with D.I. water.
11. Air dry.

All glassware is rinsed with reference seawater prior to mixing concentrations.

A 1-l glass volumetric flask, various sizes of volumetric pipettes, and a 250 ml graduated cylinder are used to prepare solutions. A total volume of 1600 ml is needed for each concentration; eight replicates and one 400 ml sample for measuring chemical parameters. Effluent concentrations are set according to client requirements.

Hypersaline brine is used to adjust salinity. Six to eight liters of reference seawater are frozen 48 hours before the test. After 24 hours, the water is allowed to partially thaw for about one hour and the liquid is combined into a 1-liter container. If the salinity is not between 60 and 80 ppt, the container is frozen again for 24 hours. After an hour of thawing, the water is separated from the ice. The salinity is then usually between 60 and 80 ppt.

The amount of brine to add to each effluent concentration to obtain a final salinity of 20 $\pm$ 2 ppt is calculated using the following formula:

$$VB = VE \frac{(20 - SE)}{(SB - 20)}$$

VB=Volume of Brine to add
VE=Volume of Effluent to add
SE=Salinity of Effluent
SB=Salinity of Brine

Brine controls are used in all tests when salinity adjustment is necessary. The brine controls contain the same amount of brine added to the highest effluent concentration plus D.I. water equal to the amount of effluent added and filled to the 1-l mark with reference seawater. The pH of all brine mixtures are checked and adjusted to within 0.1 units of the dilution water by dropwise addition of dilute HCl or NaOH.

Effluents with a salinity greater than 10 ppt, or tests with effluent concentrations greater than 10% use the following formula to calculate the amount of D.I. to add:

$$VB = VE \frac{(20)}{(SB - 20)}$$

The amount of D.I. to add is calculated by solving for VE.

Effluent concentrations are prepared by combining effluent, hypersaline brine and dilution water using the appropriate dilution factors, volumetric pipets and flasks. Concentrations are mixed from the lowest to the highest to avoid any possible contamination.

STANDARD TOXICANT CONCENTRATIONS

Stock solutions of copper chloride are prepared by Environmental Resource Associates in Arvada, Colorado. The 10,000 ug/l stock is traceable to NBS standards and is guaranteed stable for up to one year. Stocks are replaced after one year or sooner if necessary.
A reference test is performed concurrently with each effluent test conducted.
A sample of stock solution is analyzed for verification of the copper concentration by a local, certified laboratory at the time of the test to ensure there is no contamination. Solutions consist of eight replicates each of 10, 18, 32, 56 and 100 ug/l copper. Solutions are renewed three times throughout the test.

SHIPPING OF TEST ORGANISMS

One to three day old mysids are shipped from Aquatox in Hot Springs, Arkansas and arrive the following day. Animals are held in cleaned 20 liter glass aquaria at a density of no more than 20 mysids per liter. Animals are slowly acclimated to test conditions during the holding period. Mysids are fed twice per day and the water is changed every other day.

CHEMICAL PARAMETERS

Dissolved oxygen is measured at the beginning and end of each 24-hour exposure in one test chamber at all test concentrations and in the control. Temperature, pH, and salinity are measured at the end of each 24-hour exposure period in one test chamber at all test concentrations and in the control. pH is measured in the effluent samples daily.

INITIATION OF THE TEST

After concentrations are prepared and chemical measurements are recorded, 5 animals are carefully transferred into each Nytex cylinder using a disposable transfer pipet. Aftertransfer, mysids are fed <24 hour old *Artemia* nauplii.

INCUBATION

Mysids in test containers are placed under low light (50 to 100 footcandles) at 26$\pm$ 1 deg C with a photoperiod of 16 hours light and 8 hours dark. Test salinity is 20-30 $\pm$ 2 ppt. Thermographs continuously record temperatures through-out the the testing period. Containers are covered with plastic wrap to prevent evaporation during the test. Aeration is only necessary when the D.O. falls below 60%.

TEST SOLUTION RENEWAL

Test solutions are renewed daily and prepared in clean 1000 ml beakers. Each Nytex cylinder is carefully lifted from the old solution and transferred into the new solution taking care not to disturb the mysids. The effluent which has been stored in the refrigerator is warmed to 26 deg C before mixing solutions.

Before transferring mysids, the bottom of each petri dish is cleaned of all debris by siphoning with a transfer pipet. Numbers of live animals are recorded and all dead animals are removed.

The mysids are fed enough <24 hour old *Artemia* nauplii twice per day to ensure that some *Artemia* remain alive overnight. The *Artemia* are rinsed with filtered seawater prior to being added to test chambers.

New food suitability is determined in a side-by-side test using four replicates. One treatment is fed the new food and the other is fed food known to be suitable.

TERMINATION OF TEST

After 7 days, the test is terminated. Most of the test solution is poured off and replaced with clean water. The number of surviving immatures, males, females with eggs, and females without eggs is recorded. The larvae are rinsed in D.I. water and placed in clean, tared aluminum weigh boats and dried at 105 deg C for 6 hours. Immediately after removal from the oven, boats are placed in a desiccator overnight to completely cool before weighing. All weights are measured to the nearest 0.01 mg. The average dry weight is determined for each replicate.

ANALYSIS

A review of concentration-response relationships as well as a comparison of the percent minimum significant difference (PMSD) measured in the test with the PMSD bound variability is conducted on all multi-concentration tests following guidelines in EPA821-B-00-004, July 2000, *Method Guidance and Recommendations for Whole Effluent Toxicity (Wet) Testing (40 CFR Part 136).* The flowcharts for statistical analysis of survival and growth (biomass) as described in the EPA manual are followed to obtain NOEC estimates.

TEST ACCEPTABILITY

1) Control survival must be greater than 80%.

2) Average dry weight must be greater than 0.20 mg/mysid in the controls.

3) Control fecundity should also be used if egg production by 50% of females is achieved.

REFERENCES

USEPA. 2002. *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms.* EPA-821-R-02-014.

USEPA. 1991. *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms.* EPA-600/4-91/003.

USEPA. 1988. *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms.* EPA-600/4-87/028.

Revised 11/3/2006

STANDARD OPERATING PROCEDURE

STANDARD OPERATING PROCEDURES FOR THE 28 DAY SEDIMENT SURVIVAL & GROWTH, BIOASSAY WITH *Neanthes arenaceodentata*

(Army Corps of Engineers, Inland Testing Manual)

Prepared By:

Aquatic Bioassay & Consulting Laboratories, Inc.

March 10, 2010

STANDARD OPERATING PROCEDURES FOR THE 28 DAY SEDIMENT SURVIVAL & GROWTH, BIOASSAY WITH *Neanthes arenaceodentata* (Army Corps of Engineers, Inland Testing Manual)

ENDPOINT DESCRIPTION

Neanthes arenaceodentata are exposed in a static renewal system to test solutions of sediment and control water for 28 days. The endpoints are survival and growth, (increase in weight) of *Neanthes* compared to controls.

SAMPLE COLLECTION

Samples are collected and placed into 1 liter high density polyethylene (HDPE) containers. Samples can be stored for up to eight weeks in the dark at 4°C.

TEST ORGANISMS

Neanthes arenaceodentata are supplied by Brezina and Associates in Dillon Beach, CA. Organisms are acclimated for a period greater than 96 hours and less than 14 days to reach target salinity.

OVERLYING WATER

Three types of water may be used as overlying water: 1) Receiving water - seawater collected from areas around the vicinity of outfall, 2) Natural, l-um filtered, UV sterilized salt water from University of California at Santa Barbara, 3) Reconstituted sea salts using "Tropic Marin" brand sea salts and purified D.I. water.

SEDIMENT PREPARATION

The day before the sediment test is started (Day -1) each sediment is thoroughly homogenized by passing it through a sifting screen. 1000mL of the sediment is then added to the chambers. 9L of overlying water is then added to each of the test chambers. Suspension of the sediment can be avoided by carefully pouring the water down the side of the test chamber. Chemical analysis should be taken on the initial (Day 0) and (Day 28) of the test including: pH, temperature, dissolved oxygen, salinity, and ammonia. All other dates require monitoring of the temperature and dissolved oxygen.

REFERENCE TOXICANT CONCENTRATIONS

Reference toxicants are mixed from a stock copper solution of 10.0mg/L supplied by Environmental Resource Associates. The reference toxicants are mixed in concentrations of: 20, 40, 80, 120, 160, and 200µg/L.

RENEWAL OF OVERLYING WATER

Renewal of overlying water is achieved by intermittent volume additions of 2L every day. Water is changed out every other day of testing. Test containers are maintained at 20°C with a variation of ±2°C.

PLACING ORGANISMS IN TEST CHAMBERS

Neanthes arenaceodentata are pipetted directly into test chambers. 20 organisms are used per chamber. 5 replicates are used per treatment.

FEEDING

Feeding occurs three times per week (M-W-F) after overlying water renewal. For each test chamber 1g of TetraMin is added on days 1-13 and 1.5g on days 14-28.

MONITORING A TEST

All chambers are checked daily and observations are made to assess organism behavior such as sediment avoidance. Overlying water is monitored with daily measurement of dissolved oxygen, salinity, and temperature. Ammonia and pH are checked at the beginning and end of the test.

ENDING A TEST

The final water quality analyses are taken in the test chambers. The sediment in each of the test chambers is poured through a sieve to isolate the test organisms. Mobile organisms are counted as alive. Survival information is logged on a tracking sheet for the test. Surviving organisms are placed in pre prepared weigh boats to calculate growth.

TEST DATA ANALYSIS

Survival and growth are measured at the end of the 28-d sediment toxicity test with *Neanthes arenaceodentata.* Survival endpoints are reported as the percent of surviving organisms in the treatment. Growth is often a more sensitive toxicity endpoint. Dry weight of *Neanthes* is determined by pooling all living organisms from a replicate and drying the sample at 60°C- 90°C to a constant weight. The sample is brought to room temperature in a desiccator and weighed to the nearest 0.01mg to obtain mean weight per surviving organism.

REFERENCES

United States Department of The Army EPA-823-B-98-O04 Environmental Protection US Army Corps of Engineers February ~ 1998 Agency Office of Water (4305). Evaluation of Dredged Material Proposed For Discharge in Waters of the U.S. - Testing Manual Inland Testing Manual

Revised 3/10/2010

Pastor, Behling & Wheeler, LLC

STANDARD OPERATING PROCEDURE No. 20a

FOR DATA VALIDATION

OF TOXICITY TESTS

SCOPE AND APPLICABILITY

This Standard Operating Procedure (SOP) describes a protocol for the validation of biological laboratory data collected during activities required by the Unilateral Administrative Order (UAO) for the Gulfco Marine Maintenance Superfund site. Included in this protocol are procedures to evaluate and validate data from sediment toxicity tests.

The Quality Assurance Project Plan (QAPP) and applicable SAPs must be reviewed before this SOP is used to assess laboratory data. The individual performing the data reviews shall be familiar with the biological method and other procedures used for the project. Familiarity with project and laboratory quality control requirements is critical to appropriate use of this procedure.

Quantitative determination of accuracy and precision in sediment testing of aquatic organisms is difficult, as compared to analytical (chemical) determinations. This is due in part to the variables that affect organism response. Determining the accuracy of a sediment test using field samples is not possible since the true values are not known. Because there is no acceptable reference material suitable for determining the accuracy of sediment tests, accuracy of the test methods has not been determined. Sediment tests exhibit variability due to several factors including test organism age, condition and sensitivity; handling and feeding of the test organisms; overlying water quality; and the experience of the investigators in conducting tests. For these reasons, the validation includes verification of some of the procedural elements of the biological methodology, while performance-based criteria are used to determine the quality of the culture and the test. All studies shall be performed by a well-trained analyst and shall include a negative control (for organism quality) and a positive control (for sensitivity to reference toxicant). Studies may also include tests with a reference sediment (clean sediment from the study area with the same characteristics as the test sediment), tests for effects of background contamination, tests for

acceptability of sediment type, and/or tests with a control sediment (clean sediment from the organism collection site, which can also serve as the negative control).

DEFINITIONS

Precision

Precision is a term that describes the degree to which data generated from replicate measurements differ and reflects the closeness of agreement between replicates. A measure of precision can be calculated using the mean and relative standard deviation of the calculated endpoints from the replicated endpoints of a test as follows:

Percent Coefficient of Variation, or CV% = Standard Deviation/Mean x 100)

Precision may be evaluated using reference toxicants, control sediment, and/or test samples.

Lethal concentration (LC)

The toxicant concentration that would cause death in a given percentage of the test population. It is generally qualified with a certain time period. For example, the LC50 (96-hr) is the concentration of toxicant that would cause death in 50% of the test population within a 96-hour time period.

Data Qualifier Flags

As a result of data validation, data qualifier flags may be applied to individual biological results. Definitions of the flags applied for data qualification are as follows:

Flag	Definition
J	The reported value is an estimated quantity due to minor variances in the procedure or failure to meet quality control criteria.
R	The data are not usable due to serious deficiencies in meeting quality control criteria.

PROCEDURES

Sediment Toxicity Test Data Validation

A Data Validation Checklist is attached to this SOP. The checklist will be completed to document the data validation process and will be completed according to the following procedure:

(1) Review the Tables in the QAPP and note the biological methods, procedural requirements, and performance criteria specified.

(2) Review the Chain-of-Custody records (COC). Verify that all necessary information was provided on each COC and that all required signatures are present. Verify that biological laboratory results were reported for all samples and tests listed on the COCs. Verify that custody seals were used unless samples were hand-delivered. Note any problems documented on the COCs by either the sampler or the laboratory.

(3) Review laboratory records of sample receipt to verify that samples were collected in proper containers and received in good condition with proper preservation. Data for samples received without proper preservation should be considered estimated. Document any field sample results requiring qualification based on inadequate sample preservation on the Qualified Data Table section of the Validation Checklist.

(4) Briefly summarize the laboratory's case narrative, or note if not present. Summarize any notes or comments documented throughout the laboratory report.

(5) Verify the correct field IDs are included in the laboratory report along with laboratory sample IDs, biological method references, and organism source.

(6) Verify that each sample was analyzed within the recommended holding time. Data for samples analyzed outside of the recommended holding time should be considered estimated. Document any field sample results requiring qualification based on exceedance of holding time on the Qualified Data Table section of the Validation Checklist.

(7) Verify that reference toxicant tests have been conducted with the test organism within six months of the sediment tests and that LC50 survival rates are within laboratory limits ($\pm$2 SD, 95% confidence limits). Reference toxicant tests are used to demonstrate acceptable laboratory performance and the ability to obtain precise results. Since the reference toxicant test procedures are not the same as the sediment test procedures, the tests do not directly reflect on the reproducibility of the sediment test.

(8) Review the test data to ensure standard procedures were employed to minimize variability in test results. Verify that the test organism life stage at start, number of replicates, and test duration were in compliance with method recommendations. Data comparisons, statistical or otherwise, should be made with data from standardized procedures.

(9) Review the test data to ensure that the overlying water quality was within the tolerance limits of the test organism. Data for tests performed outside of the tolerance limits should be considered estimated and may be rejected. An individual test may be conditionally acceptable if temperature, dissolved oxygen, and other specified conditions fall outside specifications, depending upon the degree of the departure. The acceptability of the test will depend on the experience and professional judgment of the laboratory analyst and validator. Document any field sample results requiring qualification based on organism tolerance on the Qualified Data Table section of the Validation Checklist.

(10) Review the negative control data to assess the quality of the organisms and the acceptability of the test. Verify that the average survival rate and the survival rate for each single replicate are within performance criteria. Problems with a study are most readily detected by failure to meet the performance criteria for the control treatment and such studies should be repeated to insure accurate results, when possible. Data for tests associated with a control that fails the criteria should be considered estimated and may be rejected. If the study includes a reference sediment and performance criteria for the reference sediment were met, it may be possible to infer that other samples that show good performance are probably not toxic; however, any samples showing poor performance should not be judged to have shown toxicity, because it is unknown whether the adverse factors that caused poor control performance might have also caused poor performance in the test treatments. Document any field sample results requiring qualification based control data on the Qualified Data Table section of the Validation Checklist.

Documentation of Validation

A Data Validation Checklist will be completed to document the verification of processes and the validation qualifiers assigned to individual results. The checklists will be included in the project file containing the associated laboratory biological reports.

DATA USE

The meaning of the qualifier flags in terms of future data uses are as follows:

Values that are assigned a J flag are considered estimated results. Data assigned these flags did not meet all of the procedural and/or performance criteria specified in the QAPP but the magnitude of the deficiency is not great enough to reject the value for project data uses.

Values assigned an R flag are considered rejected. The R flag indicates that serious deficiencies were encountered preventing the generation of usable data for the project objectives.

Values without flags assigned have met all of the project data quality objectives and are suitable for all project data uses.

QUALITY ASSURANCE

The Project QA Manager and Project Coordinator will review the completed Data Validation Checklists for conformance with the procedures described herein. Any questions or comments resulting from that review will be resolved before the checklists are considered final. The database manager will modify the project electronic database to include any data qualifiers detailed on a finalized Checklist.

DATA VALIDATION CHECKLIST Sediment Toxicity Tests				
Client Name:	Project Number:			
Property Location:	Project Manager:			
Laboratory:	Laboratory Job No.:			
Reviewer:	Date Checked:			
ITEM	**Yes**	**No**	**NA**	**Comment Number**
Chain of Custody (COC) and Sample Receipt at Lab				
1. Signed COCs included and seals used?				
2. Date and time of sample collection included?				
3. All samples listed on the COC analyzed for in accordance with the Work Plan?				
4. Samples collected in appropriate containers with proper preservation?				
5. Any problems noted?				
Laboratory Report and Data Package				
6. Signed Case Narrative included?				
7. Discrepancies noted in case narrative?				
8. Field sample IDs included?				
9. Laboratory sample IDs included?				
10. Method references included?				
11. Organism source included?				
12. Reference toxicant test included and within lab limits?				
13. Date of analysis included?				
14. Samples analyzed within holding time?				
15. Standard procedures used?				
16. Overlying water quality within tolerance limits?				
17. Control data meet performance criteria?				
Comments:				

QUALIFIED DATA TABLE

Field Sample Identification	Assigned Data Qualifier	Reason for Qualification

APPENDIX B

LABORATORY QUALITY ASSURANCE DOCUMENTS

STATEMENT OF QUALIFICATIONS, QUALITY ASSURANCE/QUALITY CONTROL MANUAL

Aquatic Bioassay
and Consulting Laboratories, Inc.
29 North Olive Street
Ventura, California 93001

(805) 643-5621

Revision #10
March 31, 2009

STATEMENT OF QUALIFICATIONS, QUALITY ASSURANCE/QUALITY CONTROL MANUAL

Aquatic Bioassay
and Consulting Laboratories, Inc.
29 North Olive Street
Ventura, California 93001

(805) 643-5621

Revision #10
March 31, 2009

AQUATIC BIOASSAY AND CONSULTING, INC.
29 NORTH OLIVE STREET
VENTURA, CA 93001

QUALITY ASSURANCE MANUAL REVISION NUMBER: 10
QUALITY ASSURANCE MANUAL REVISION DATE: 3/31/09

Quality Assurance Manual Approval:

Approved by:

Name: Thomas Mikel
Title: President
Signature:
Date: 3/31/09

Concurrences:

Name: Scott C. Johnson
Title: Laboratory Director/Director,Aquatic Operations & Environmental Consulting
Signature:
Date: 3/31/09

Name: MichaelMachuzak
Title: Laboratory Manager/QC Officer
Signature:
Date: 3/31/09

TABLE OF CONTENTS

7.7. REPORTING

8. APPENDICES

8.1 EXAMPLES OF A COMPLETED BIOASSAY REPORTS

8.2. RESUMES OF KEY PERSONNEL

8.3. EXAMPLE OF A CHRONIC BIOASSAY WORKSHEET

8.4. DOHS LABORATORY CERTIFICATION

8.5. RECENT DMR & WP STUDY RESULTS

8.6. STANDARD OPERATING PROCEDURES

8.6.1. Hazardous Waste Toxicity Tests
8.6.2. Acute Effluent Toxicity Tests (EPA, 3rd Ed.)
8.6.3. Acute Effluent Toxicity Tests (EPA, 4th Ed.)
8.6.4. Acute Effluent Toxicity Tests (EPA, 5th Ed.)
8.6.5. Chronic Fathead Minnow Larvae Toxicity Test (EPA, 3rd Ed.)
8.6.6. Chronic Fathead Minnow Larvae Toxicity Test (EPA, 4th Ed.)
8.6.7. *Ceriodaphnia* Survival and Reproduction Toxicity Test (EPA, 3rd Ed.)
8.6.8. *Ceriodaphnia* Survival and Reproduction Toxicity Test (EPA, 4th Ed.)
8.6.9. *Selenastrum capricornutum* Toxicity Test (EPA, 3rd Ed.)
8.6.10. *Selenastrum capricornutum* Toxicity Test (EPA, 4th Ed.)
8.6.11. Chronic Silversides Minnow Toxicity Test
8.6.12. Red Abalone Toxicity Test
8.6.13. Giant Kelp Toxicity Test
8.6.14. Purple Sea Urchin Fertilization Toxicity Test
8.6.15. Purple Sea Urchin Larval Development Toxicity Test
8.6.16. Mysid Shrimp Sediment Toxicity Test
8.6.17. Chronic *Mysidopsis bahia* Shrimp Toxicity Test
8.6.18. Chronic *Holmesimysis costata* Shrimp Toxicity Test
8.6.19. Chronic Topsmelt Toxicity Test
8.6.20. Thermometer Calibration and Daily Temperature Monitoring
8.6.21. Total and Fecal Coliform Bacteriology (Multiple Tube Technique)
8.6.22. Inhibitory Residue Testing on Glassware and Plasticware
8.6.23. Sterility of Sampling Containers
8.6.24. Effectiveness of Sterilization in the Autoclave
8.6.25. Dissolved Oxygen, Modified Winkler and DO Probe
8.6.26. Biological Oxygen Demand (BOD)
8.6.27. *Hyalella azteca* 10 Day Sediment Survival Test

1. INTRODUCTION

Aquatic Bioassay's Biologists and Oceanographers have been performing Aquatic Bioassays and Marine Monitoring Surveys since 1971. We are fully equipped to perform all freshwater or marine, acute or chronic bioassays on hazardous wastes, wastewater, drilling fluids, or benthic sediments in compliance with NPDES, ASTM, USEPA/COE, or DOHS regulations. With over 130 bioassay clients in California and other states, we are one of the most successful bioassay laboratories on the West Coast.

The Aquatic Bioassay Team has a reputation for being able to accomplish projects after others have failed. In short, we will provide a bioassay or marine monitoring program that is cost effective, of the highest quality possible, and with a responsiveness that is totally unique to this company.

2. COMPANY BACKGROUND AND EXPERIENCE

From 1976, Thomas (Tim) Mikel served as Chief Biologist and subsequent Laboratory Director of CRL Environmental (formerly Jacobs Environmental). Immediately following the takeover of CRL Environmental by Enseco, Inc. in 1988, Mr. Mikel broke out on his own and formed Aquatic Bioassay and Consulting Laboratories, Inc.

Within less than a year, the Company had won a six-year receiving water monitoring program for the City of Oxnard, the largest municipal program in central California. This was followed almost immediately by long term monitoring projects for Chevron at Carpinteria and at Gaviota, and a current meter study for a Texaco offshore oil platform near Point Conception. Following the initiation of the Oxnard monitoring project, Mr. Mikel designed two acute and two chronic bioassay laboratories.

At the present time, Aquatic Bioassay performs acute and chronic, freshwater and marine bioassays for over 100 laboratories, municipalities, consultants, and industries throughout the state, and is one of the most highly regarded aquatic bioassay laboratories in California.

3. FACILITIES

3.1. LABORATORIES

Aquatic Bioassay occupies a 5000 square-foot building in Ventura, California. The facility is divided into three bioassay incubator rooms, a bioassay laboratory, a marine monitoring laboratory, and a video microscopy laboratory (Figure 3-1). A complete list of laboratory equipment is included in Table 3-1.

Marine Incubator Room. Aquatic bioassay supports three bioassay incubators maintained at 15, 20, and 25 deg C. The coldest room is used for conducting most marine acute and chronic bioassays and houses a 500 gallon seawater holding tank, 0.2 micron water filtration system, and three 50 gallon holding tanks for adult marine species. Tests include acute bioassays (crangon shrimp, speckled sanddabs, and three-spine sticklebacks), chronic bioassays (sea urchin fertilization, abalone development, and kelp spore germination and growth), and sediment and drill mud bioassays.

Acute Freshwater Incubator Room. The 20 deg C room is used for hazardous waste bioassays (DOHS, Title 22) and freshwater NPDES wastewater bioassays using adult fathead minnows.

Chronic Freshwater Incubator Room. The 25 deg C room is used for freshwater chronic bioassays, including the fathead minnow larval survival and growth test, the *Ceriodaphnia* survival and reproduction test, and the *Selenastrum* algae growth test. The marine silversides minnow survival and growth test is also conducted in this incubator.

Bioassay Laboratory. This laboratory houses instruments and supplies needed for measuring freshwater and marine chronic species. Equipment includes light tables, a Coulter Counter, analytical balances, water baths, drying ovens, and deionized water system with a final bank of water polishing cartridge.

Marine Monitoring Laboratory. The marine monitoring laboratory is designed for the evaluation of ocean water, sediments, and biota. Equipment includes glassware and instruments for measuring suspended solids, oil and grease, ammonia, turbidity, and coliform bacteria in marine waters; a series of brass screens and shaker device for the measurement of grain size in sediments; and microscopes, light tables, videos, and a complete taxononomic library for the identification of benthic and pelagic marine organisms.

Video Microscopy Laboratory. This laboratory is used for the counting and evaluation of most marine chronic bioassays. To reduce fatigue and improve accuracy, a bank of three inverted microscopes has been fitted with high resolution video cameras connected to video screens.

3.2. TEMPERATURE AND LIGHT CONTROL

Temperature control for both chronic and acute bioassay laboratories are conducted by forced-air heating and air conditioning units specially designed for laboratory purposes. The computerized thermostat adjusts the temperatures in these laboratories every two seconds. The lower temperatures for the marine species, however, required a more innovative approach. The marine incubator and holding area were thoroughly insulated and coverted into a walk-in refrigerator. A compressor on the roof of the building runs a refrigeration unit mounted in the room. This keeps the temperature range within less than one degree of 15 Centigrade. In order to keep this area dry, dehumidifiers are in operation at all times.

The light regime for all incubators and holding areas is 16 hours light and 8 hours dark at an intensity of 50 $\pm$ 5 microeinsteins.

3.3. FRESH AND MARINE WATER SOURCES

Two completely independent, large capacity deionizing units serve the laboratory. This redundancy assures that deionized water is always available. For chronic dilution waters, the deionized water is further refined to the equivalent of a Millipore Milli-Q System: two ion-exchange cartridges followed by carbon and organic clean-up cartridges.

Marine bioassay dilution water is either local coastal water or water collected in the open ocean near Anacapa Island. Seawater is collected into a plastic 500-gallon tank mounted on a trailer. Water is then transferred to our 500-gallon seawater storage tanks housed in our 15 deg C marine holding area. Before use, the water is pumped through activated carbon, 1 micron, 0.45 micron, and 0.20 micron filters.

3.4. TEST ORGANISMS: SOURCES, CULTURING AND HOLDING

Test organisms for aquatic bioassays are either collected locally or obtained from a licensed supplier. Purple sea urchins, and giant kelp are obtained from Proteus Sea Farms in Oxnard, California, Kim Siewers in Santa Cruz, California or Dave Gutoff in San Diego, California. Abalone spawners are obtained from the Cultured Abalone in Goleta, California or US Abalone in Davenport, California. Adult fathead minnows are obtained from Thomas Fish Company in Anderson, California. Other adult marine fish and invertebrates are obtained from various suppliers including, Brezina and Associates in Dillon Beach, California, Northwestern Aquatics in Oregon, and Aquatic Research Organisms in Hampton, NH. Fathead and silversides minnow larvae are obtained from Aquatic Research Organisms in Hampton, NH and *Ceriodaphnia* and *Selenastrum* populations are cultured in house.

For adult organisms 50, 65, and 100 gallon fiberglass tanks are utilized as holding aquaria. Freshwater holding water is made up from reagent grade chemicals in deionized water. Seawater holding water is made from either natural coastal water filtered through a 0.2 micron filter (see above) or standard sea salts dissolved in deionized water. Water is recirculated in each holding tank through a fiberglass filter, an activated carbon filter, and a gravel or crushed coral trickling filter specially designed for these holding tanks.

Holding waters and animal conditions are monitored daily. This includes monitoring of dissolved oxygen and temperature as well as indicating daily feeding and noting any behaviorial anomalies. In addition, the temperature of the shipping is recorded upon arrival to verify that the organisms are not subject to temperature changes of more than 3° C in a 12-hour period. Also, at a minimum of once per week, ammonia, salinity (for seawater), and temperature are checked in each holding tank. Also weekly, tanks are cleaned of detritus and 50% of the water is changed. Dead or unhealthy looking organisms are always removed immediately.

3.5. DATA ANALYSIS CAPABILITIES

Aquatic Bioassay is equipped with several IBM compatible personal and lap top computers. Programs include Excel, Word, ToxCalc, NCSS, IGODS and StatMost.

Aquatic Bioassay reports typically include a signed cover letter with the final results, error bar charts showing means and standard deviations for all concentrations, chemical analysis table, raw data table, and statistical data sheet. Example of completed freshwater and marine chronic bioassay reports are included in Appendix 9.1.

4. STAFF QUALIFICATIONS AND EXPERIENCE

4.1. DESCRIPTION OF STAFF RESPONSIBILITIES

In addition to staff biologists and technicians, three key members of the Aquatic Bioassay team are directly responsible for the bioassay program. Mr. Thomas (Tim) Mikel is the owner and president. Mr. Johnson serves as Laboratory Director, directly supervising all staff during the whole bioassay program. He remains in constant communication with the Laboratory Manager, Mr. Machuzak who also serves as the Laboratories' QA/QC Officer.

4.2. EDUCATION AND EXPERIENCE OF KEY PERSONNEL

Complete resumes of the five key team members are included as Appendix 9.2. The following bioparagraphs summarize their experience.

Mr. Thomas (Tim) Mikel is the owner and president of Aquatic Bioassay. His 20 years of experience have included Laboratory Directorships of CRL Environmental, Jacobs Laboratory, and the Santa Barbara Underseas Foundation. He has held Senior Marine Biologist positions for PJB Laboratories and the U.S. Department of the Interior. He designed the Ecological Restoration Project of Upper Newport Bay and was the Biological Coordinator of the Anacapa Island Underwater Nature Trail. Mr. Mikel has been Project Manager for scores of marine surveys in Central and Southern California. He is a frequent speaker for workshops in the field of environmental biology and has developed and published bioassay techniques being used in California today. He is biographed in Who's Who in America and American Men and Women in Science. He is the Chair of the Methods Committee of the Southern California Toxicity Assessment Group and is the Mollusk Bioassay Section Chair for the 20th Edition of *Standard Methods*. Mr. Mikel holds Bachelor's and Master's degrees in Marine Biology from Moss Landing Marine Laboratories and University of California, Santa Barbara, respectively.

Mr. Scott Johnson is the Director of Aquatic Bioassay and Project Manager for all Oceanographic and Aquatic Biology field projects. In addition, he is responsible for for all ocean and freshwater monitoring and laboratory operations, environmental assessments, toxicity reporting and environmental consulting. He is responsible for the NPDES marine monitoring programs for the largest municipal dischargers on the central California coast including the cities of Oxnard, Goleta, Santa Barbara, Avalon, and San Luis Obispo. Mr. Johnson was promoted from Water Biologist to Supervisor, then finally to Manager of the Biology Laboratories for the City of Los Angeles' Environmental Monitoring Division. He was responsible for all facets of the City's Santa Monica Bay and Los Angeles River NPDES monitoring programs including water quality, bacteriololgy, benthic ecology, toxicity testing, reporting and permit negotiations. Mr. Johnson was chairperson of the Southern California Toxicity Assessment Group Policy Committee for four years and has numerous scientific papers and presentations to his credit. Mr. Johnson holds both a Masters and Bachelors degrees in Biology (minor in Chemistry) from California State University, Long Beach.

Mr. Michael Machuzak is responsible for the coordination of all acute and chronic bioassays at *Aquatic Bioassay*. He was the Biological Director of Ab Lab, CRL Environmental, and Jacobs Laboratories and authored several original papers on marine bioassays and aquaculture. Mr. Machuzak is member of the *Field Sampling and Logistics Committee for the Southern California Bight Project-Bight 1998*. He received his technical education at Eastern Kentucky University and University of California, Santa Barbara.

Ms. Karin Wisenbaker conducts and supervises microbiological testing with IDEXX. Assists in report preparation, set-up and analysis, client interface and quality control. Ms. Wisenbaker holds a B.S. in Environmental Biology from California State University Northridge.

Ms. Beth Maturino conducts and supervises bioassay testing in our laboratory and is responsible for quality assurance and quality control (QA/QC). Ms. Maturino is a member of the *Microbiology Group* for the *Southern California Bight Project, Bight '98.*

Mr. Joe Freas responsible for chronic and acute, freshwater and marine bioassays. Assists in bioassay report preparation, set-up and analysis, client interface and quality control. Mr. Freas is also responsible for new toxicity testing method development and implemitation. Mr. Freas hold a B.S. in Biology from California State University Channel Islands.

4.3. LABORATORY CERTIFICATIONS

Aquatic Bioassay is certified by the Department of Health Services for Aquatic Toxicity Bioassays for Hazardous Waste and all NPDES bioassay methods. As well as microbiological testing of recreational waters. Our complete laboratory certification is included in Appendix 9.4. Aquatic Bioassay and Consulting, Inc. participates in the DMR-QA studies as well as annual WP studies.

5. TEST SPECIES UTILIZED FOR BIOASSAY TESTING

ORGANISM	TEST TYPE	REFERENCES
Freshwater Species		
Fathead minnows (*Pimephales promelas*)	Acute, Chronic	1,2,3,4,10,11, 16, 17
Rainbow trout (*Oncorhynchus mykiss*)	Acute	1,2,3,11, 16
Water fleas (*Ceriodaphnia,Daphnia spp.*)	Acute, Chronic	4,11, 16, 17
Green algae (*Selenastrum capricornutum*)	Chronic	4, 17
Estuarine/Marine Species		
Three-spine stickleback (*Gasterosteus aculeatus*)	Acute	1,2,3
Silversides minnow (*Menidia beryllina*)	Acute, Chronic	6,11, 16, 17
Topsmelt (*Atherinops affinis*)	Chronic	8
Atlantic mysid (*Mysidopsis bahia*)	Acute, Chronic	5,6,11,13, 16
Giant kelp (*Macrocystis pyrifera*)	Chronic	8
Red abalone (*Haliotus rufescens*)	Chronic	8
Sea urchins (*Strongylocentrotus spp.*)	Chronic	8
Sand dollar (*Dendraster excentricus*)	Chronic	8
Amphipod (*Eohaustorius spp.*)	Acute	15
Bivalves (*Mytilus, Tellina spp.*)	Acute, Chronic	5,8,9
Polychaetes (*Nephtys, Neanthes spp.*)	Acute, Chronic	5,14

1. APHA. *Standard Methods for the Examination of Water and Wastewater.* (Latest Edition).

2. USEPA. 1985. *Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms.* (3rd Ed.) EPA/600/4-85/013.

3. Kopperdahl, F. 1976. *Guidelines for Performing Static Acute Bioassays for Municipal and Industrial Wastewaters.* Calif. Dept. Fish and Game.

4. USEPA. 1994. *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms*. EPA-600/4-91/002.

5. USEPA and COE. 1991. *Evaluation of Dredged Material Proposed for Ocean Disposal.* EPA/503/8-91/001.

6. USEPA. 1988. *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms*. EPA-600/4-91/003.

7. Machuzak, M. and T. Mikel. 1987. Drilling fluid bioassays using Pacific Ocean mysid shrimp, *Acanthomysis sculpta*, a preliminary introduction. In: *Aquatic Toxicology and Hazard Assessment.* ASTM STP 971. Philadelphia. pp.447-53.

8. USEPA. 1995. *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms.* EPA/600/R-95/136.

9. ASTM. 1987. Standard Practice for conducting static acute toxicity tests with the larvae of four species of bivalve mollusks. E724-80. ASTM. Philadelphia.

10. Polisini, J.M. and R.G. Miller. 1988. Static acute bioassay procedures for hazardous waste samples. California Dept. of Fish and Game.

11. USEPA. 1993. *Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms*. (4th Ed.). EPA/600/4-90/027F.

12. ASTM. 1990. Standard guide for conducting static 96-h toxicity tests with microalgae. E1218-90. ASTM. Philadelphia.

13. Fed. Reg. 1993. Federal Register. Vol.58, No.41, Appendix 2, pp. 12507-12.

14. USEPA. 1991. *Recommended Guidelines for Conducting Laboratory Bioassays on Puget Sound Sediments*. USEPA, Seattle.

15. ASTM. 1993. Guide for conducting 10-day static sediment toxicity tests with marine and estuarine amphipods. E1367-92. ASTM. Philadelphia.

16. USEPA. 2002. *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms*. (5th ed). EPA-821-R-02-012.

17. USEPA. 2002. *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms*. EPA-821-R-02-013.

6. RECENT BIOASSAY CLIENTS

Aquatic Bioassay Biologists have performed tens of thousands of bioassays since 1976 and currently conduct tests for 10 of the 12 Regional Water Quality Control Board Districts in California, making us one of the most experienced group of bioassay biologists in the State. Highlights of some of our work are described below:

Marine Acute and Chronic Bioassays. *Aquatic Bioassay* Biologists were the first commercial group of scientists to successfully perform the chronic abalone larval bioassay designed by the California Department of Fish and Game. Our testing organisms include mysid shrimp, silversides minnows, topsmelt, sea urchins, abalone, bivalves, kelp, and amphipods. *Aquatic Bioassay* has been conducting side-by-side multi-species studies for such groups as NRG Energy (three Southern California power plants), AERA, SWARS, Chevron, Pacific Operators Offshore, Orange County Sanitation Districts, San Luis Obispo County, Cities of Oxnard, Avalon, Pismo Beach, Monterey, Marina del Rey, Summerland, Carpinteria, Santa Barbara, San Elijo Joint Powers Authority, the Southern California Bight Projects, (Bight 98 and Bight 03), and the Central Coast Regional Water Quality Control Board.

Freshwater Acute and Chronic Bioassays. *Aquatic Bioassay* routinely conducts freshwater and marine chronic tests for Los Angeles County, Cities of Los Angeles, San Luis Obispo, Simi Valley, Thousand Oaks, Camarillo, Ojai, Ventura, Lompoc, Moorpark, Riverside, County of Orange Environmental Resources Division, Victor Valley, Santa Barbara, , Burbank, Beaumont, Yuba City, Valley Sanitation District, as well as Fallbrook Public Utilites, Encina Wastewater Authority. Test species include fathead minnows, green algae, rainbow trout, water fleas, and other daphnids.

Sediment and Drilling Fluid Bioassays. After conducting numerous suspended phase, solid phase, and bioaccumulation sediment bioassays, Aquatic Bioassay Biologists published the only procedure applicable for Pacific Ocean mysid shrimps (M.J. Machuzak and T.K. Mikel, *Drilling Fluid Bioassays Using Pacific Ocean Mysid Shrimp, Acanthomysis sculpta, a Preliminary Introduction* in *Aquatic Toxicity and Hazard Assessment,* 10th Vol. ASTM STP 971). Clients have included the Los Angeles Department of Water and Power, Southern California Bight Project, Larry Walker Associates, Calleguas Municipal Water District, Chevron, Exxon, Shell Oil, Torch Operations, the U.S. Navy, Burns and McDonnell, San Diego Harbor, County of Orange Environmental Resources Division, and the City of Oxnard.

6.1. RELATED WORK EXPERIENCE

PROJECTS

Our Laboratory Director has been conducting bioassays since 1976. Aquatic Bioassay has performed thousands of tests since 1988, making it one the most experienced bioassay laboratories in California. A list of clients is included in Table 6-1, and several projects are described below:

DynCorp. Dr. Robert Brent, 703-461-2401, Aquatic Bioassay participated in acute and chronic toxicity testing for the EPA for WET interlaboratory studies in 1998. Aquatic Bioassay was selected as one of nine laboratories nation wide to participate as an EPA sponsored laboratory.

Southern California Bight Project, (Bight 98, Bight 03 and Bight 08). Dr. Steve Weisberg, SCCWRP, 714-894-2222, During the summers of 1998, 2003 and 2008, Aquatic Bioassay conducted marine sediment bioassays on numerous samples from sites within the Southern California Bight.

NRG Energy. Mr. Alex Sanchez, 310-529-3280, Since 1995, Aquatic Bioassay has been conducting chronic and acute marine bioassays for Long Beach and El Segundo power stations.

Pacific Gas & Electric. Mr. Jim Kelly, 805-545-3194, In June of 1997 we began performing chronic toxicity bioassays for four PG&E power plants on effluent and influent water samples.

County of Orange Environmental Resources Division, Mr. Bruce Moore, 714-567-6373, Aquatic Bioassay conducts marine and freshwater acute and chronic toxicity tests for the County of Orange Environmental Resources Division.

Other long-term marine chronic programs include: Pacific Gas and Electric, City of Oxnard, City of San Luis Obispo, City of Avalon, City of Pismo Beach, City of Monterey, City of Santa Barbara, Montecito Sanitation District, Summerland, Chevron at Gaviota, Santa Ana Regional Water Quality Control Board, Phillips Petroleum at Santa Maria, and the Central Coast Regional Water Quality Control Board,

TABLE 6-1. COMPLETE LIST OF AQUATIC BIOASSAY CLIENTS.

Municipalities and Government

City of Avalon	Avalon, Ca.
Cen. Coast RWQCB	San Luis Obispo, Ca.
City of Camarillo	Camarillo, Ca.
City of Carpinteria	Carpinteria, Ca.
Elsinore Municipal	Lake Elsinore, Ca.
Las Virgenes Muni. Water Dist.	Calabasas, Ca.
City of Lompoc	Lompoc, Ca.
City of Los Angeles	Playa Del Rey, Ca.
County of Los Angeles	Whittier, Ca.
Marina Del Rey Harbor	Marina Del Rey, Ca.
Montecito Sanitary District	Montecito, Ca.
Moorpark San. Dist.	Moorpark, Ca.
Ojai Valley Sanitation Dist.	Ojai, Ca.
City of Oxnard	Oxnard, Ca.
City of Pismo Beach	Pismo Beach, Ca.
City of San Luis Obispo	San Luis Obispo, Ca.
City of Santa Barbara	Santa Barbara, Ca.
City of Santa Paula	Santa Paula, Ca.
City of Simi Valley	Simi Valley, Ca.
Summerland Sanitation District	Summerland, Ca.
South San Luis Obispo San. Dist.	Oceano, Ca.
City of Thousand Oaks	Thousand Oaks, Ca.
Valley Sanitation Dist.	Indio, Ca.
City of Ventura	Ventura, Ca.
Victor Valley Water Reclaim.	Victorville, Ca.
Yuba City San. Dist.	Yuba City, Ca.

Industries

American Fruit Processing	Pacoima, Ca.
Baxter Healthcare	McGaw Park, Il.
Chevron USA	Gaviota, Ca.
CMS Generating Station	Imperial, Ca.
Dexter Electronics	Industry, Ca.
NRG Energy	El Segundo, Ca.

Laboratories and Consultants

A&L Western Laboratories	Modesto, Ca.
Applied Environmental Tech.	Ventura, Ca.
American Environmental Testing	Los Angeles, Ca.
American Analytical	Chatsworth, Ca.
ANLAB	Sacramento, Ca.
Applied P & Ch Laboratory	Pomona, Ca.
Babcock Laboratories	Riverside, Ca.

BC Analytical	Anaheim, Ca.
Best Environmental	Garden Grove, Ca.
BSK Analytical	Fresno, Ca.
Cal Sciences	Garden Grove, Ca.
Creek Environmental	San Luis Obispo, Ca
Curtis and Thompkins	Berkeley, Ca.
Envirochem	Pomona, Ca.
FGL Environmental	Santa Paula, Ca.
FGL Environmental	Stockton, Ca.
Montgomery Laboratories	Pasadena, Ca.
Orange Coast Environmental	Tustin, Ca.
URS Consultants	San Francisco, Ca.
West Coast Environmental	Ventura, Ca.
West Coast Analytical	Santa Fe Springs, Ca.
Zymax Envirotechnology	San Luis Obispo, Ca.

7. DATA QUALITY OBJECTIVES, ASSURANCE AND QUALITY CONTROL

The management and staff of Aquatic Bioassay and Consulting are committed to providing services that are scientifically valid, legally defensible and of known precision and accuracy in order to meet or exceed the definitions and expectations of quality of our clients. To the extent possible, data are reported only if all quality control measures for a particular test are acceptable. In order to determine the validity of a test all acceptability criteria specified in the associated SOP must be met or the test is rejected as invalid. To that end the following procedures are followed to ensure these quality objectives are met.

7.1. CHAIN OF CUSTODY PROCEDURES, SAMPLE HANDLING AND SAMPLE DISPOSAL

An example of Aquatic Bioassay's chain of custody form is included in Figure 7-1. The chain of custody form is completed by the person collecting the effluent or other sample. Whenever the sample changes hands, the person relinquishing the sample, as well as the person receiving the sample, sign the chain of custody and record the date and time of the transferrence. The original chain of custody form remains with the sample until it is returned to the client with the final report.

Upon arrival to this laboratory, the temperature of each sample is recorded and each sample is given a separate sequential analytical number which is included on the sample container, the laboratory logbook, and laboratory work sheets. The samples are kept in chronological order as received in a designated cold storage area unless an aliquot is being removed for analysis. Samples that are to be tested under EPA testing proceedures must have the tests initiated within 36 hours of sample collection. Upon completion of testing, those samples that are deemed to be non-hazardous are disposed of via regular waste hauler. If samples are determined to be of a hazardous nature, the unused portion of sample is returned to the client. All effluent samples are discharged to municipal sewage. A log is kept near the door of the designated storage area, and any sample removal is documented with the analyst's initials and date and time of removal. Visitors to the laboratory must sign in and be escorted by a staff member. Storage and documentation areas are locked during evenings and weekends.

7.2. GOOD LABORATORY PRACTICES AND PERFORMANCE AUDITS

The performance of "good laboratory practices" are present in every aspect of Aquatic Bioassay's testing program. As the new chronic tests are being developed, Aquatic Bioassay scientists are constantly striving to determine what procedures will improve the accuracy and precision of these tests. In addition, Aquatic Bioassay and Consulting participates in all DMRQA studies, PT studies, and all voluntary performance based exercises available, annually at a minimum. These exercises provide the Aquatic Bioassay management with the information needed to assess the performance of the staff as well as the validity of the testing procedures employed in our laboratory.

All results from these studies are shared with all agencies we conduct testing for as well as all state and local regulatory agencies. More formal practices are listed below.

FIGURE 7.1. AQUATIC BIOASSAY CHAIN-OF-CUSTODY RECORD

CHAIN OF CUSTODY RECORD

Client:	Project Name/Number:	Analysis
Address	Project Mgr.	
	P.O. #	
Phone Number:	Sampled By (signature)	

Date	Time	Comp	Grab	Matrix	Sample ID	Volume/ Number											Comments

Relinquised By:(signature)	Date Time	Relinquised By:(signature)	Date Time
Received By (signature)	Date Time	Received By:(signature)	Date Time
		Temperature upon receipt °C	

Aquatic Bioassay and Consulting Laboratories
[illegible] N. Olive Street Ventura, CA [illegible] Phone [illegible] Fax [illegible]

Published Testing Procedures. Aquatic Bioassay adheres strictly to the published methodologies and does not deviate from them in order to make the testing easier or more profitable. Senior personnel are active members of Policy, QA/QC, and Methods Development committees of the Southern California Toxicity Assessment Group (SCTAG), where recommendations for modification are formally presented.

Choice of Chemicals. Aquatic Bioassay uses only reagent grade chemicals and the highest grade of sea salts available. As discussed above (Section 3.4.), dilution water is Type III grade or better, or for marine species, noncontaminated natural seawater collected far from shore and filtered through 0.2 micron filters.

Testing Chambers and Laboratory Glasssware. Whenever possible, testing chambers are of the disposable type (e.g. culture flasks for sea urchin and abalone larval tests). Otherwise, the highest quality glassware is prepared with strict adherence to published cleaning procedures.

Standard Toxicants. During early methods development of marine chronic tests, we discovered low precision among laboratories with regard to the accurate chemical measurement of standard toxicants. Since we felt that this was a likely major source of bioassay result variability among laboratories, we decided to contract with ERA Associates in Arvada, Colorado to prepare for us copper chloride and zinc sulfate stock solutions traceable to National Bureau of Standards solutions. Stock solutions are verified monthly for accuracy by an independent chemistry laboratory.

Instrument Calibration. All laboratory instruments are zeroed and calibrated before each use. Instruments and equipment are carefully maintained, and any deviations from normal response are brought to the attention the Laboratory Director (See Section 7.4. below).

7.3. REFERENCE TOXICANT TESTING AND QUALITY CONTROL CHARTS.

All bioassay reference toxicant results are recorded and mathematically reduced for inclusion in Quality Control (QC) Charts. Standard toxicant testing is performed with each batch of chronic tests and for each new population of adult acute animals. Following each test, the LC or EC50 is calculated and included with acceptability data on a QC Data Sheet (Table 7-1). Our QC Charts are constructed from the means and standard deviations of these data (Figure 7-2).

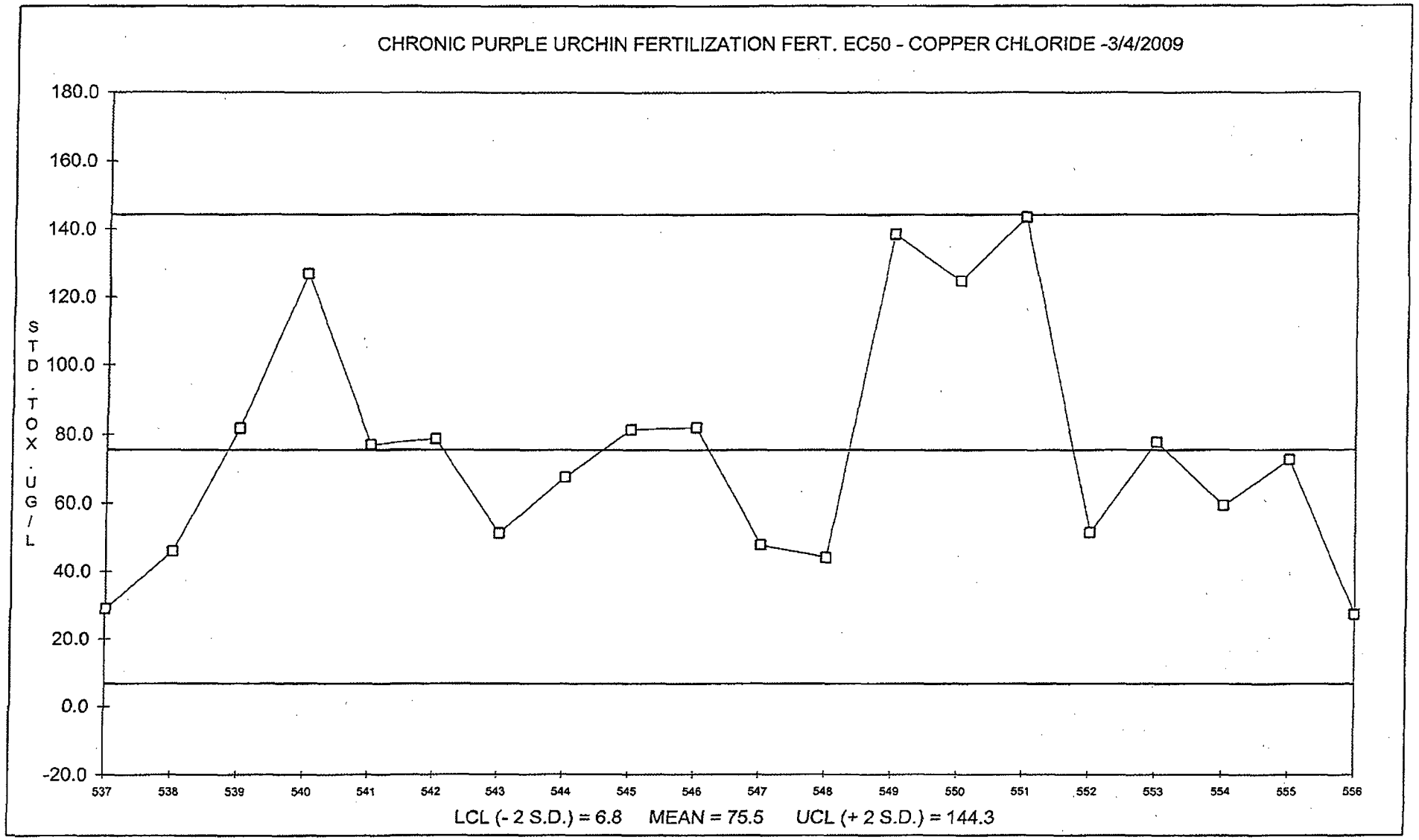
In general, new QC Charts are recalculated whenever a value approaches either the upper or lower control limit. The previous 19 acceptable data previous to this test are then included in the new chart. The current test's acceptability can then be determined. Only those tests which achieve all acceptability criteria and fall within the range of the control limits are included in subsequent control chart calculations.

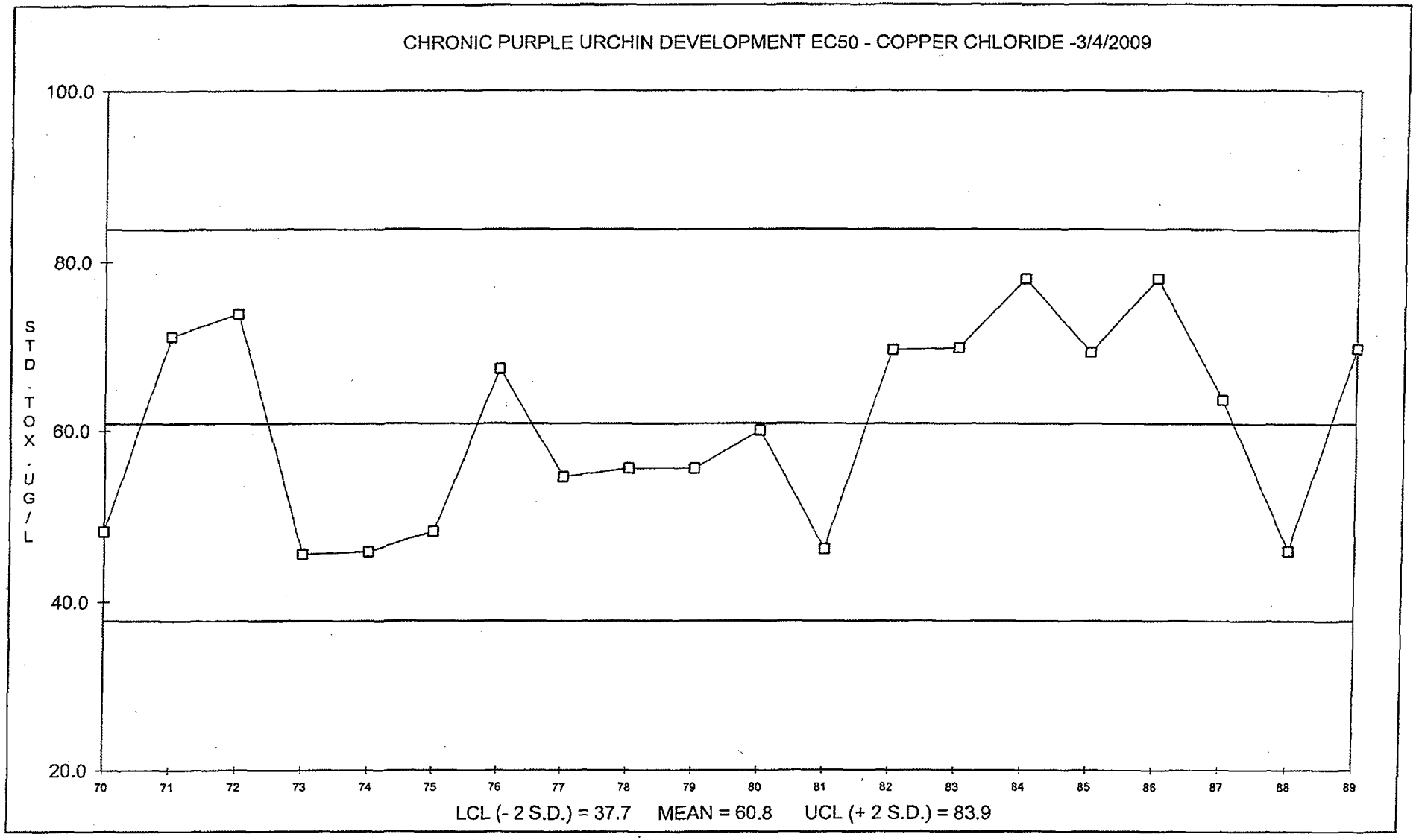
If a reference toxicant result falls outside of any acceptability requirement, all associated bioassays are reperformed. If the test is found to be acceptable, but the LC or EC50 is outside of the control limits, the QC Officer completes a Control Limit Exceedence Form (Table 7-2) which is brought to the attention of the Laboratory Director. The QC Officer, Laboratory Director, and analyst(s) then determine what the cause of the exceedance was and what will be the best corrective action. QC Charts are also used by the staff to follow seasonal, batch, annual or other temporal trends.

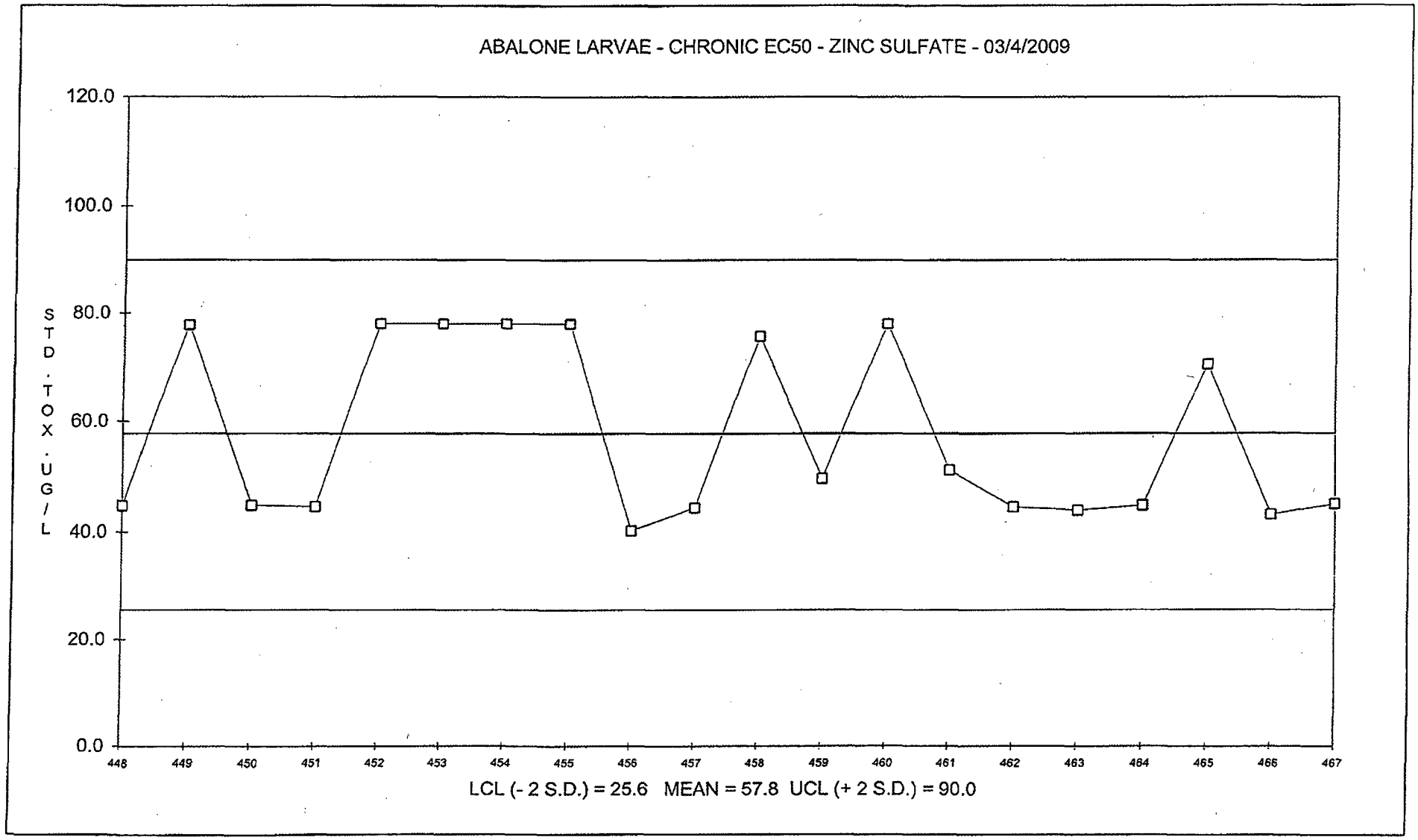
Table 7-1. BACTERIUS BIOLUMINESCENS QA/QC DATA SHEET
Standard Toxicant:

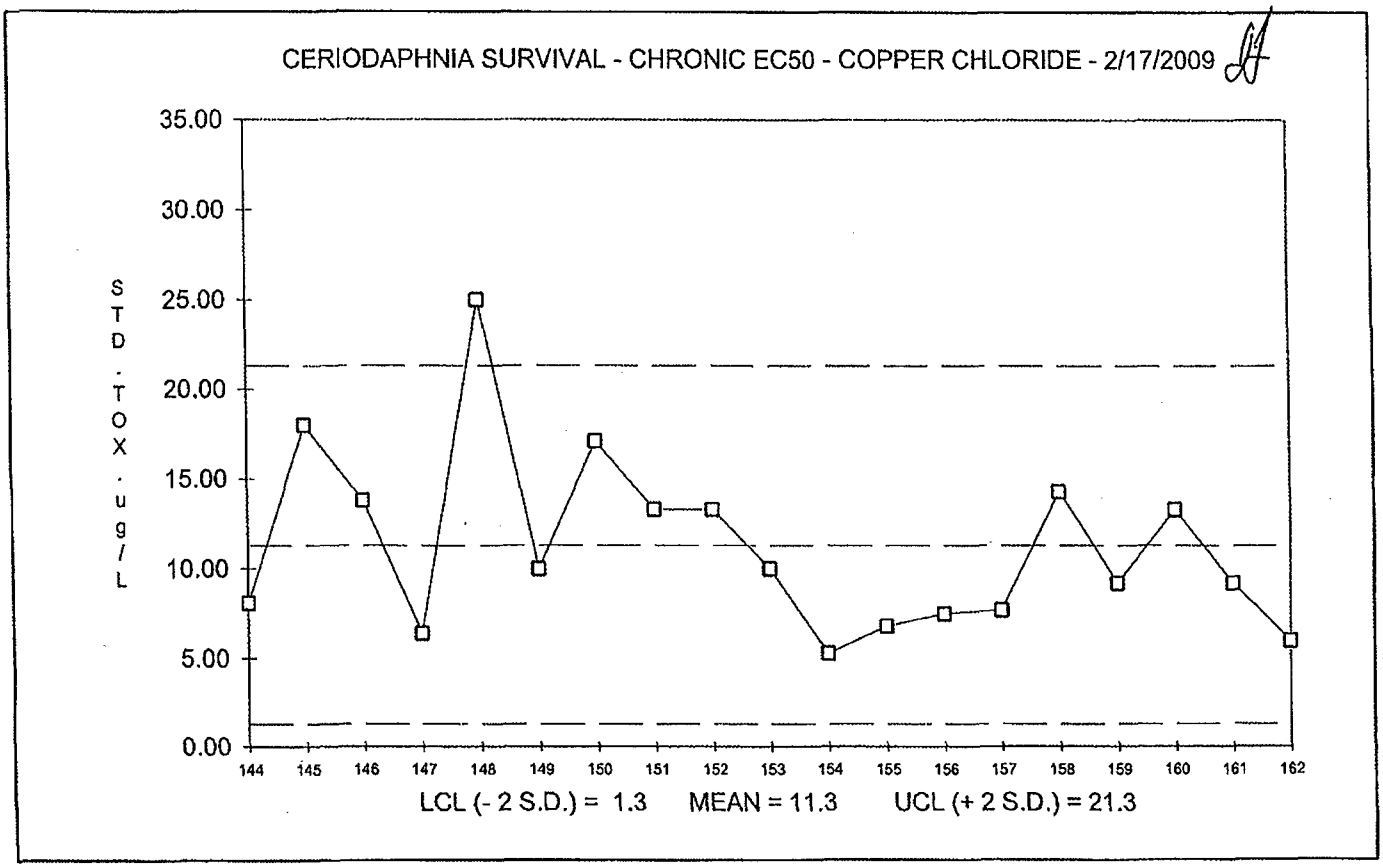
Date	Mean Control >= 80%	MS Within <= 100.0	NOEC < 50 ug/l	EC50

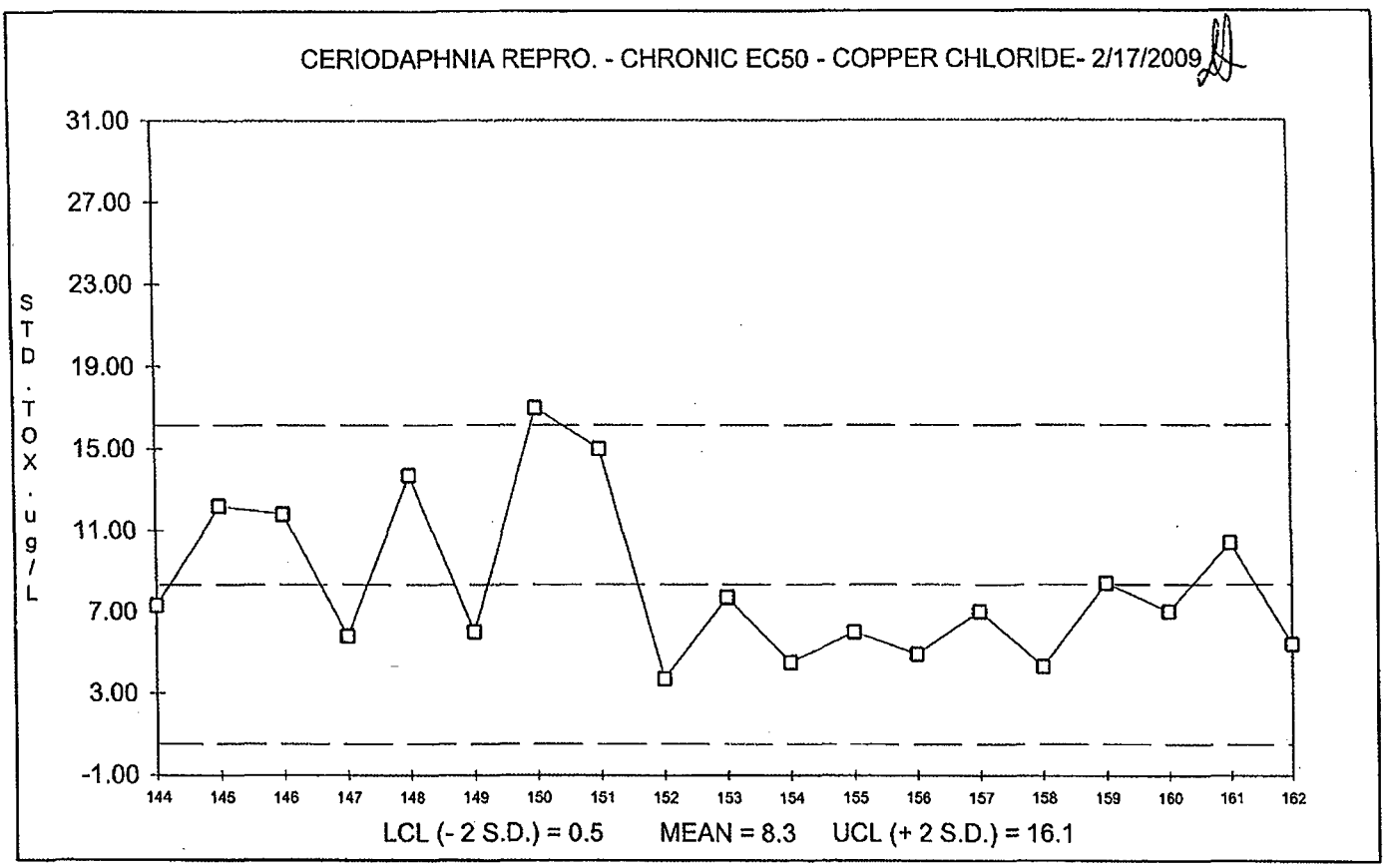
Notes:

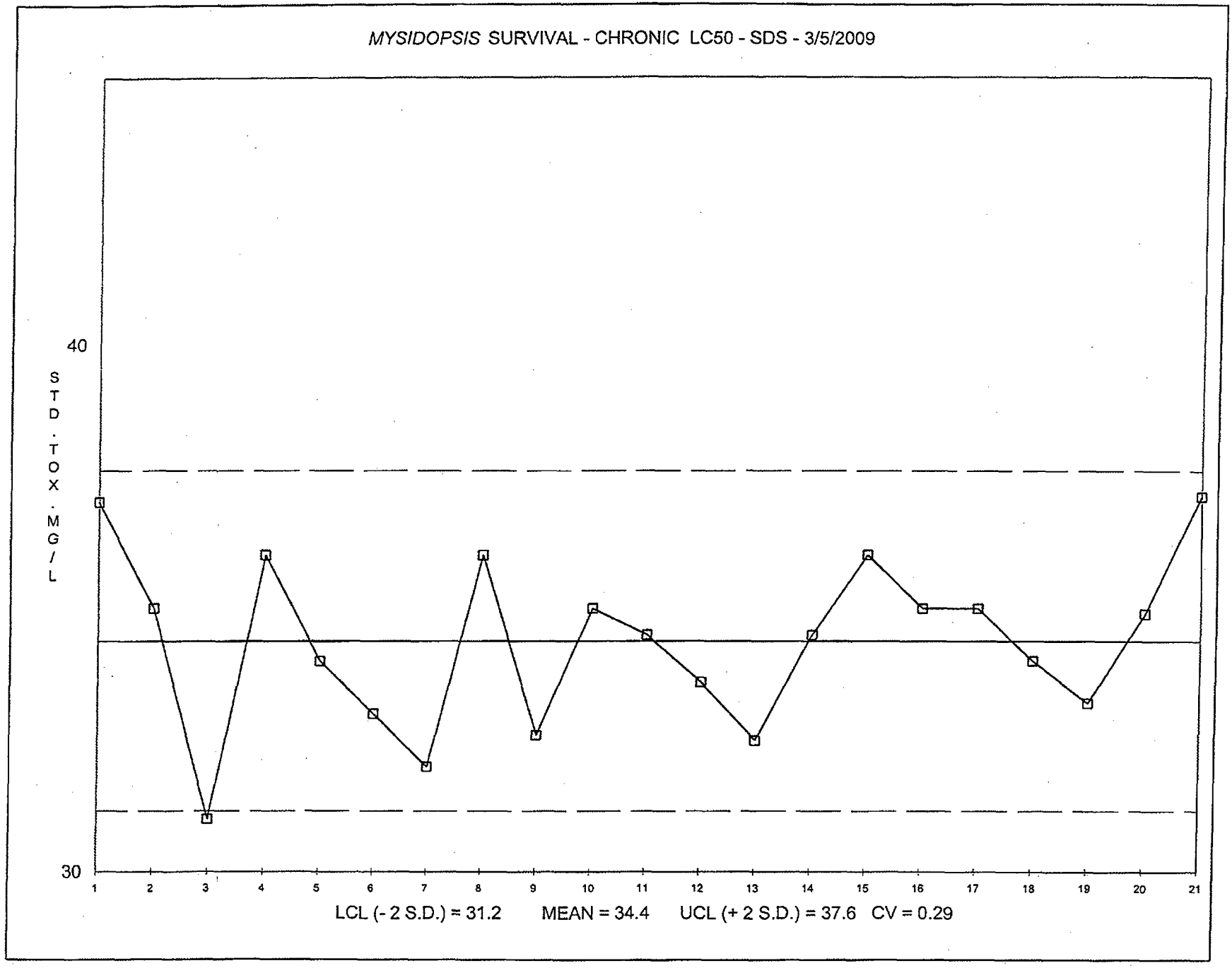

CHRONIC PURPLE URCHIN FERTILIZATION FERT. EC50 - COPPER CHLORIDE -3/4/2009
STD.TOX.UG/L
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
-20.0
537
538
539
540
541
542
543
544
545
546
547
548
549
550
551
552
553
554
555
556
LCL (- 2 S.D.) = 6.8 MEAN = 75.5 UCL (+ 2 S.D.) = 144.3

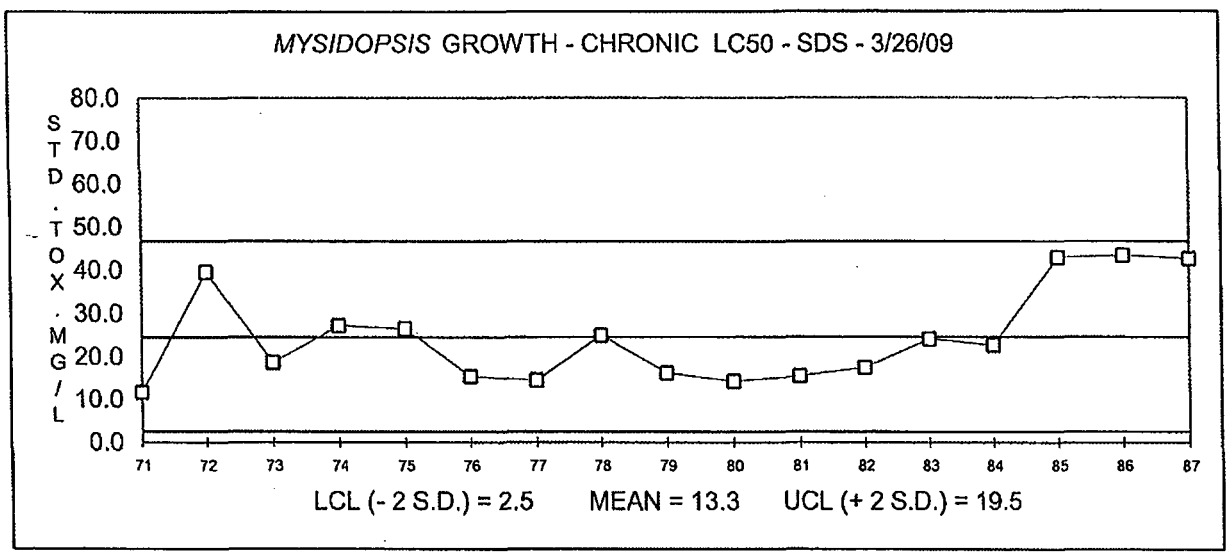

CHRONIC PURPLE URCHIN DEVELOPMENT EC50 - COPPER CHLORIDE -3/4/2009
100.0
80.0
60.0
40.0
20.0
STD.TOX.UG/L
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
LCL (- 2 S.D.) = 37.7 MEAN = 60.8 UCL (+ 2 S.D.) = 83.9

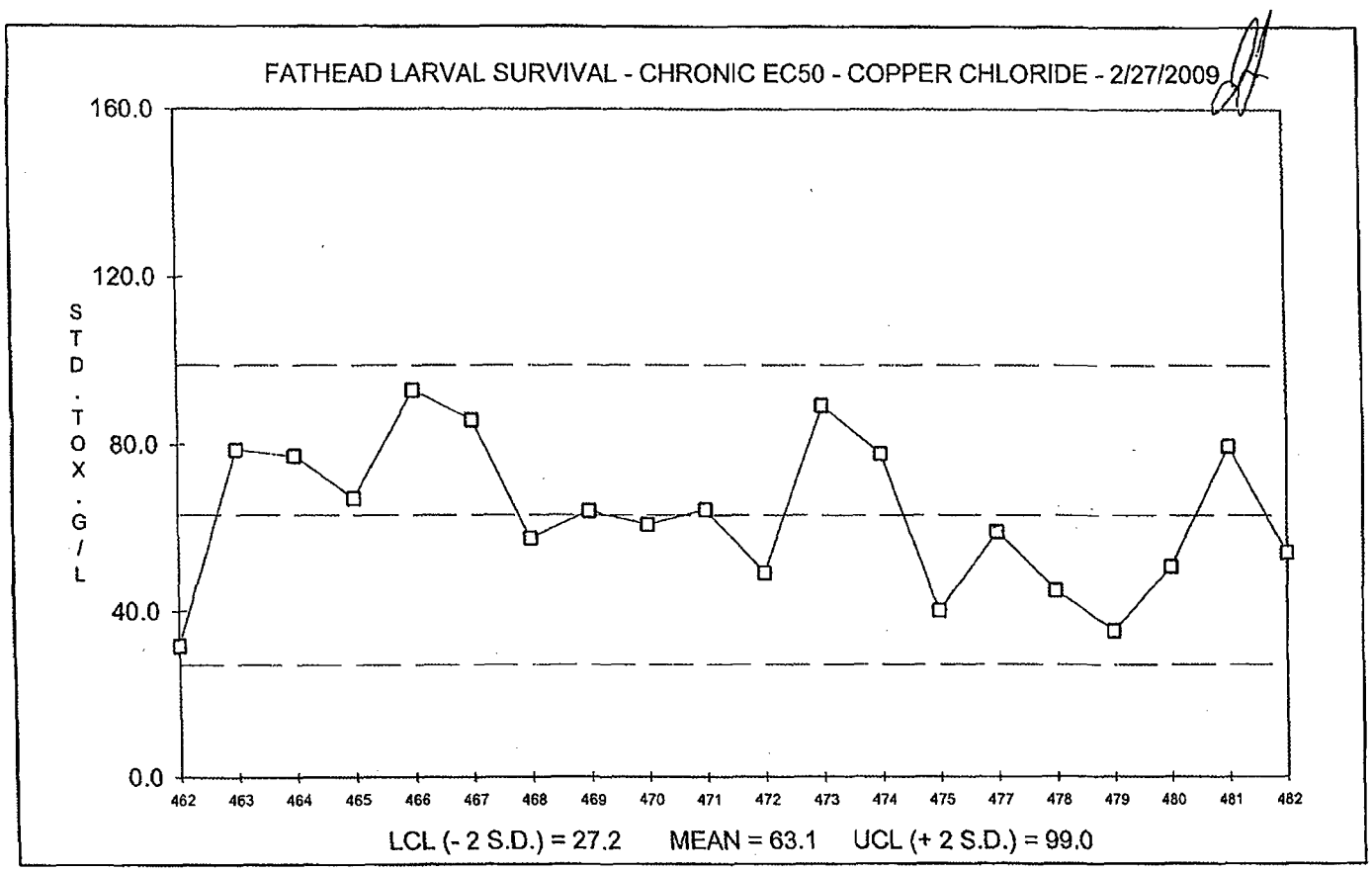

ABALONE LARVAE - CHRONIC EC50 - ZINC SULFATE - 03/4/2009
120.0
100.0
80.0
60.0
40.0
20.0
0.0
STD.TOX.UG/L
448
449
450
451
452
453
454
455
456
457
458
459
460
461
462
463
464
465
466
467
LCL (- 2 S.D.) = 25.6 MEAN = 57.8 UCL (+ 2 S.D.) = 90.0


CERIODAPHNIA SURVIVAL - CHRONIC EC50 - COPPER CHLORIDE - 2/17/2009
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
STD-TOX-ug/L
144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162
LCL (- 2 S.D.) = 1.3 MEAN = 11.3 UCL (+ 2 S.D.) = 21.3

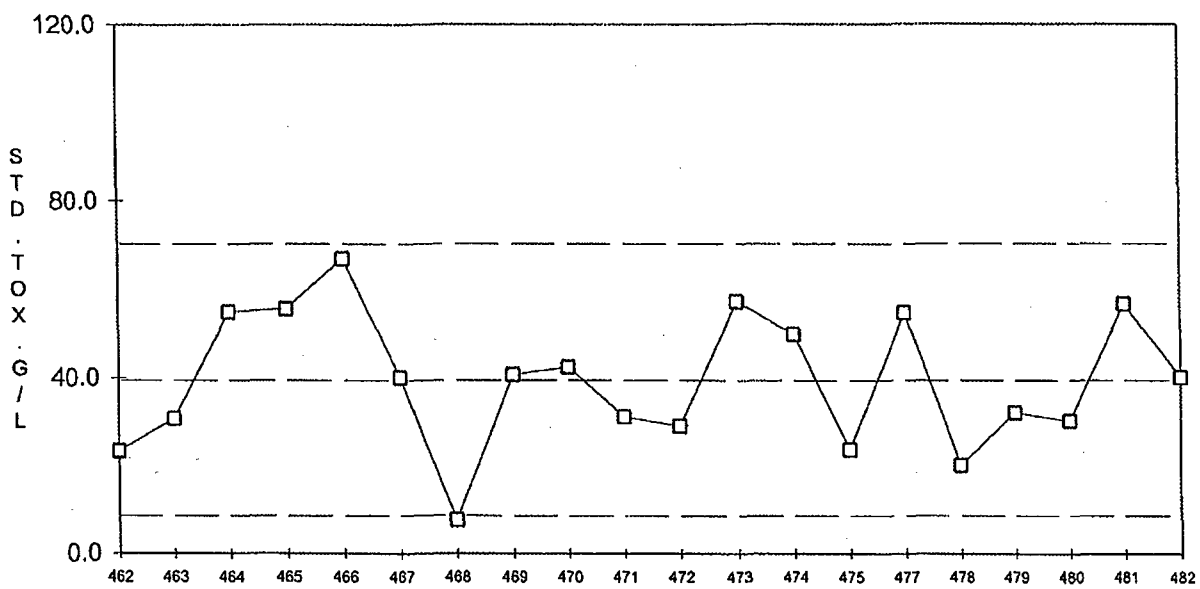

CERIODAPHNIA REPRO. - CHRONIC EC50 - COPPER CHLORIDE- 2/17/2009
STD.TOX.ug/L
31.00
27.00
23.00
19.00
15.00
11.00
7.00
3.00
-1.00
144
145
146
147
148
149
150
151
152
153
154
155
156
157
158
159
160
161
162
LCL (- 2 S.D.) = 0.5
MEAN = 8.3
UCL (+ 2 S.D.) = 16.1


MYSIDOPSIS SURVIVAL - CHRONIC LC50 - SDS - 3/5/2009
STD.TOX.MG/L
40
30
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
LCL (- 2 S.D.) = 31.2
MEAN = 34.4
UCL (+ 2 S.D.) = 37.6
CV = 0.29

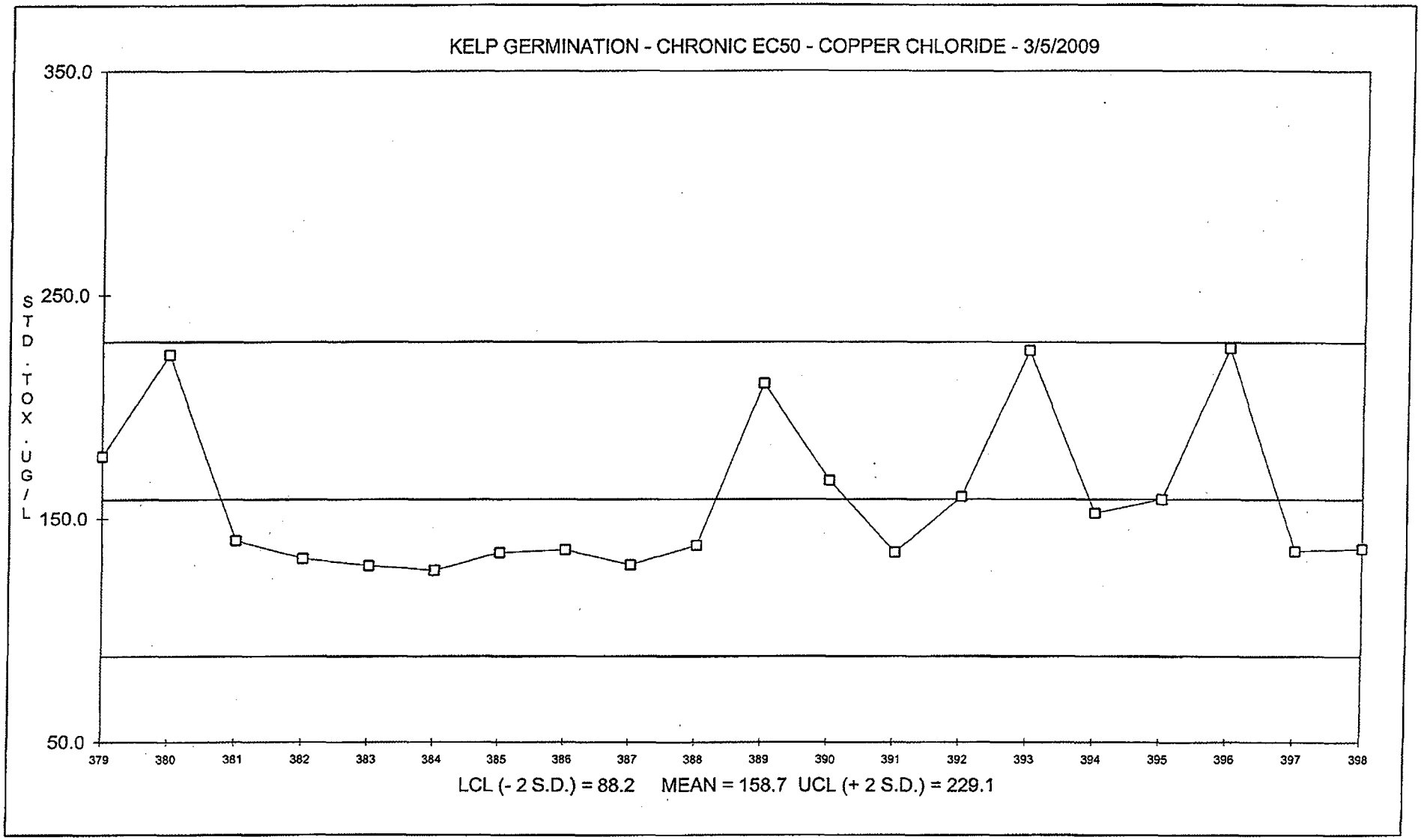

MYSIDOPSIS GROWTH - CHRONIC LC50 - SDS - 3/26/09
STD. TOX. MG/L
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
LCL (- 2 S.D.) = 2.5
MEAN = 13.3
UCL (+ 2 S.D.) = 19.5

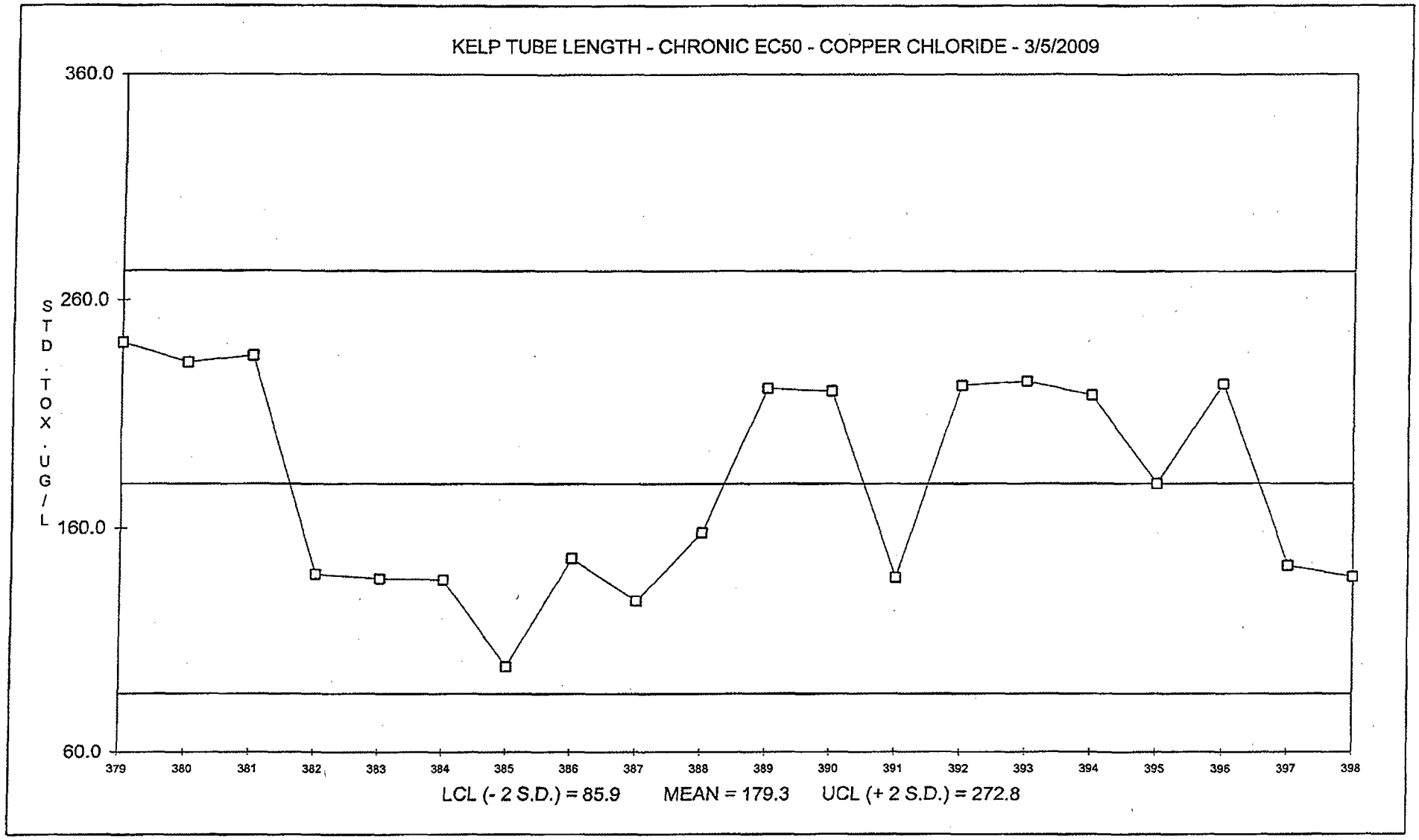

FATHEAD LARVAL SURVIVAL - CHRONIC EC50 - COPPER CHLORIDE - 2/27/2009
160.0
120.0
80.0
40.0
0.0
STD.TOX.G/L
462 463 464 465 466 467 468 469 470 471 472 473 474 475 477 478 479 480 481 482
LCL (- 2 S.D.) = 27.2 MEAN = 63.1 UCL (+ 2 S.D.) = 99.0

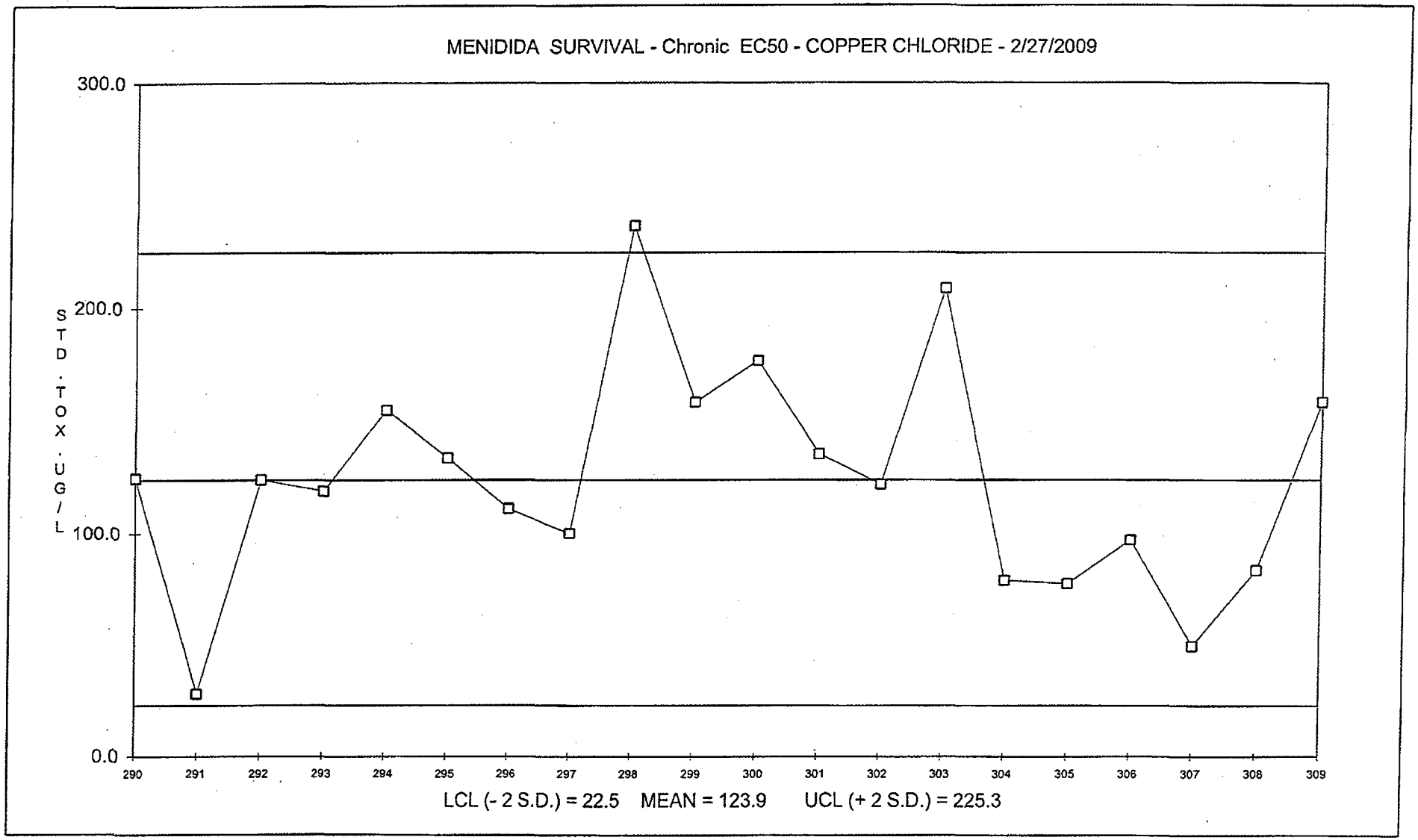
FATHEAD LARVAL GROWTH - CHRONIC EC50 - COPPER CHLORIDE - 2/27/2009

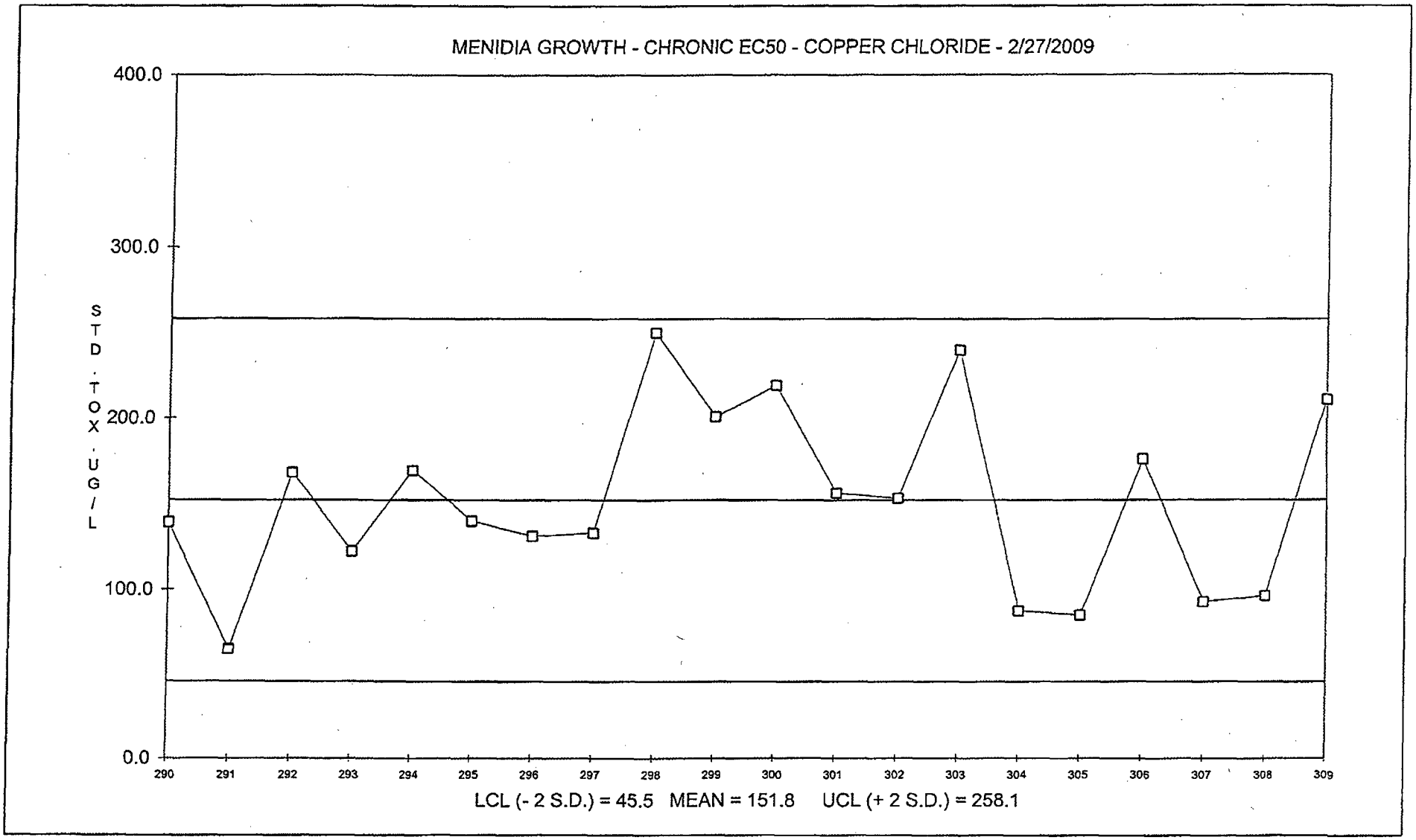


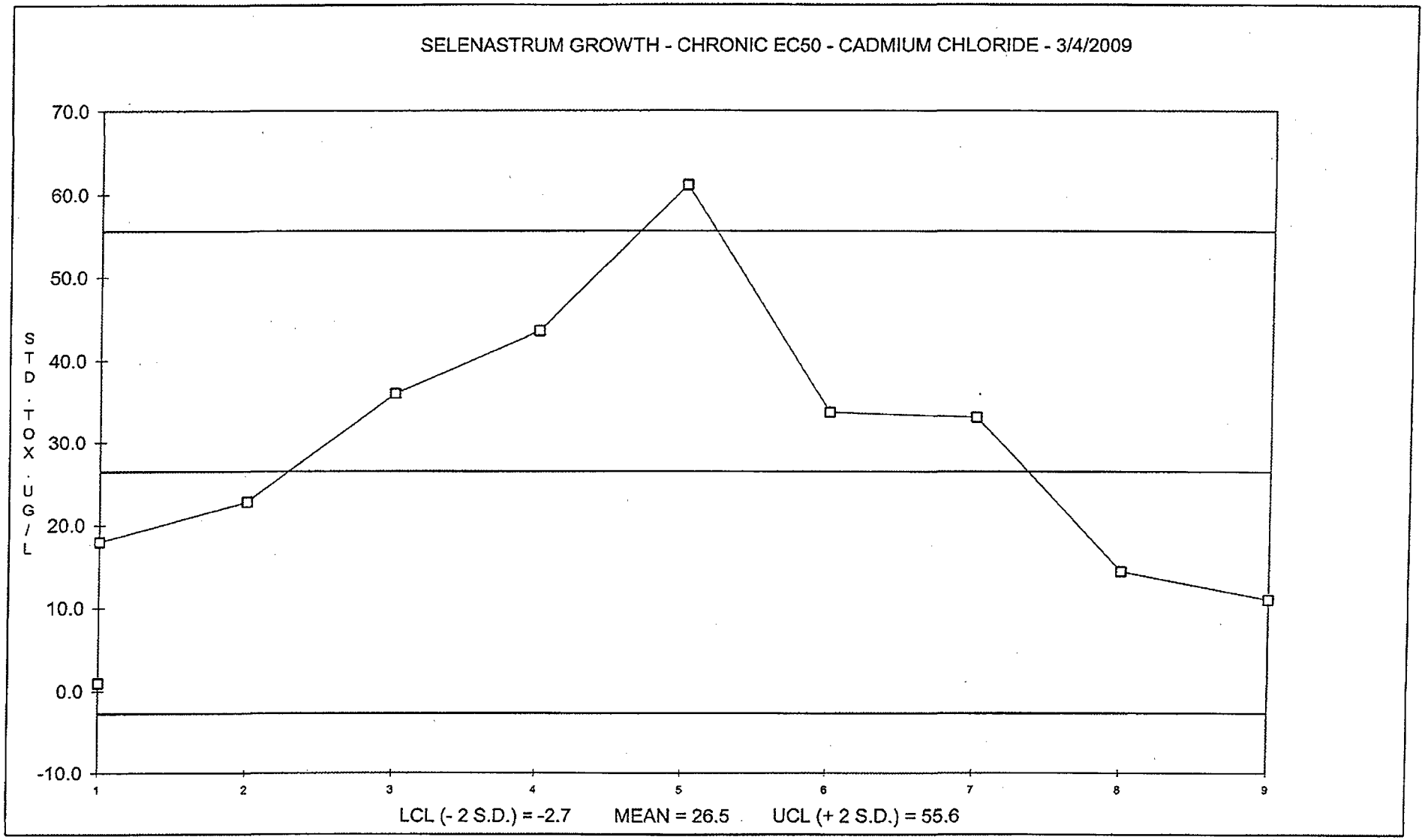
LCL (- 2 S.D.) = 8.5 MEAN = 39.4 UCL (+ 2 S.D.) = 70.3

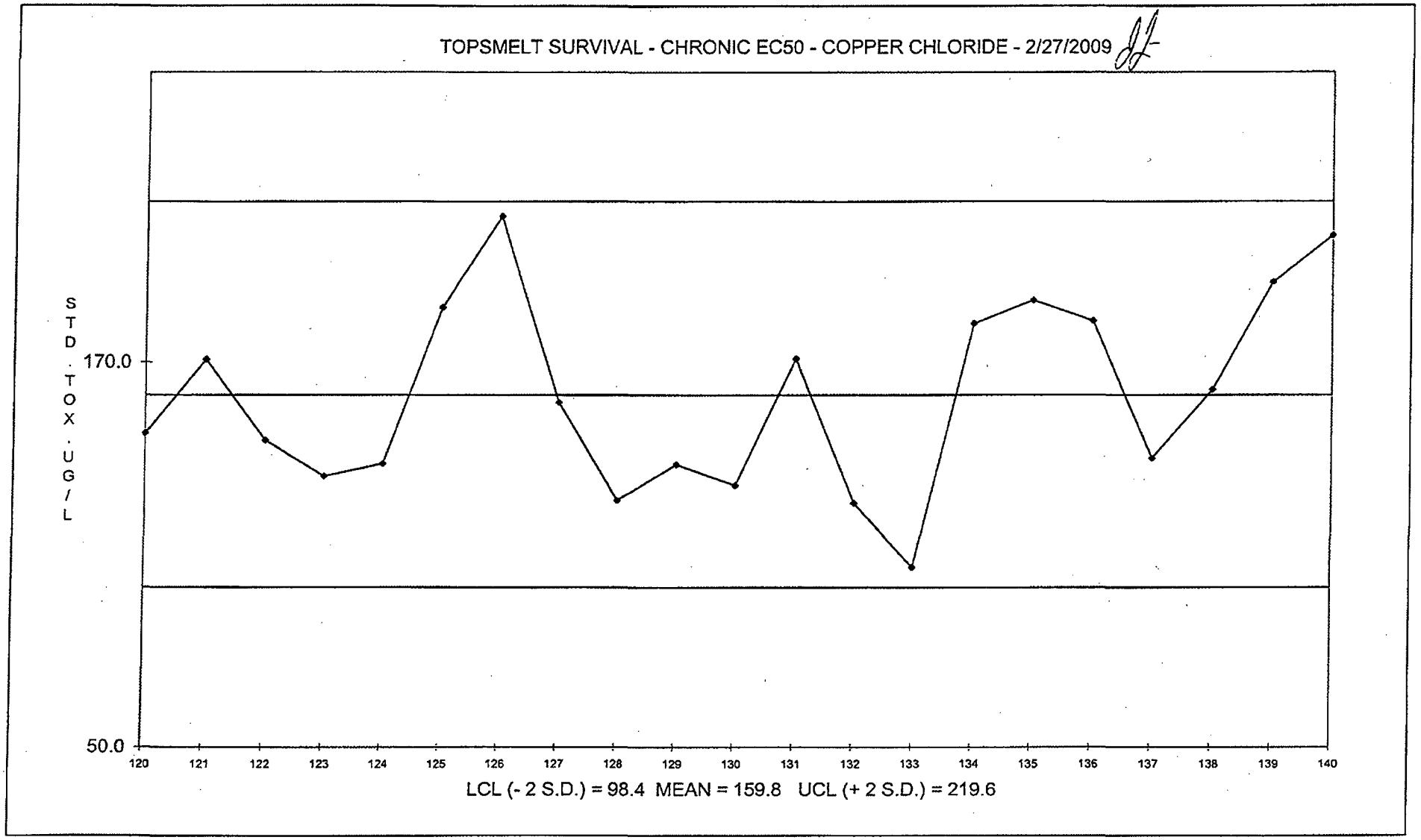

KELP GERMINATION - CHRONIC EC50 - COPPER CHLORIDE - 3/5/2009
350.0
250.0
150.0
50.0
STD.TOX.UG/L
379
380
381
382
383
384
385
386
387
388
389
390
391
392
393
394
395
396
397
398
LCL (- 2 S.D.) = 88.2
MEAN = 158.7
UCL (+ 2 S.D.) = 229.1

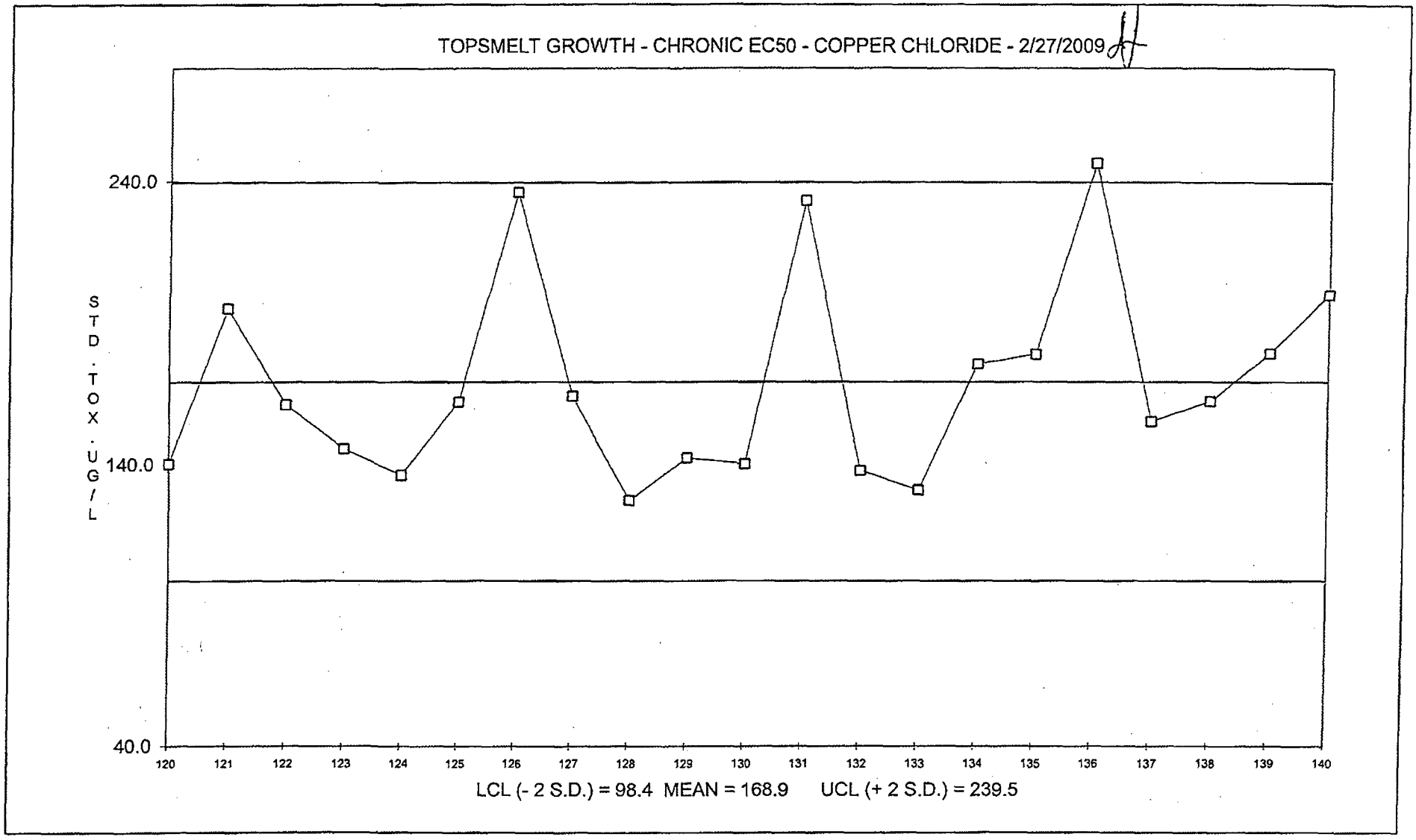

KELP TUBE LENGTH - CHRONIC EC50 - COPPER CHLORIDE - 3/5/2009
360.0
260.0
160.0
60.0
STD.TOX.UG/L
379
380
381
382
383
384
385
386
387
388
389
390
391
392
393
394
395
396
397
398
LCL (- 2 S.D.) = 85.9
MEAN = 179.3
UCL (+ 2 S.D.) = 272.8


MENIDIDA SURVIVAL - Chronic EC50 - COPPER CHLORIDE - 2/27/2009
300.0
200.0
100.0
0.0
STD.TOX.UG/L
290
291
292
293
294
295
296
297
298
299
300
301
302
303
304
305
306
307
308
309
LCL (- 2 S.D.) = 22.5 MEAN = 123.9 UCL (+ 2 S.D.) = 225.3


MENIDIA GROWTH - CHRONIC EC50 - COPPER CHLORIDE - 2/27/2009
400.0
300.0
200.0
100.0
0.0
STD.TOX.UG/L
290
291
292
293
294
295
296
297
298
299
300
301
302
303
304
305
306
307
308
309
LCL (- 2 S.D.) = 45.5 MEAN = 151.8 UCL (+ 2 S.D.) = 258.1


SELENASTRUM GROWTH - CHRONIC EC50 - CADMIUM CHLORIDE - 3/4/2009
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
-10.0
STD TOX UG/L
1
2
3
4
5
6
7
8
9
LCL (- 2 S.D.) = -2.7
MEAN = 26.5
UCL (+ 2 S.D.) = 55.6


TOPSMELT SURVIVAL - CHRONIC EC50 - COPPER CHLORIDE - 2/27/2009
STD. TOX. UG/L
170.0
50.0
120
121
122
123
124
125
126
127
128
129
130
131
132
133
134
135
136
137
138
139
140
LCL (- 2 S.D.) = 98.4 MEAN = 159.8 UCL (+ 2 S.D.) = 219.6


TOPSMELT GROWTH - CHRONIC EC50 - COPPER CHLORIDE - 2/27/2009
240.0
140.0
40.0
STD.TOX.UG/L
120
121
122
123
124
125
126
127
128
129
130
131
132
133
134
135
136
137
138
139
140
LCL (- 2 S.D.) = 98.4 MEAN = 168.9 UCL (+ 2 S.D.) = 239.5

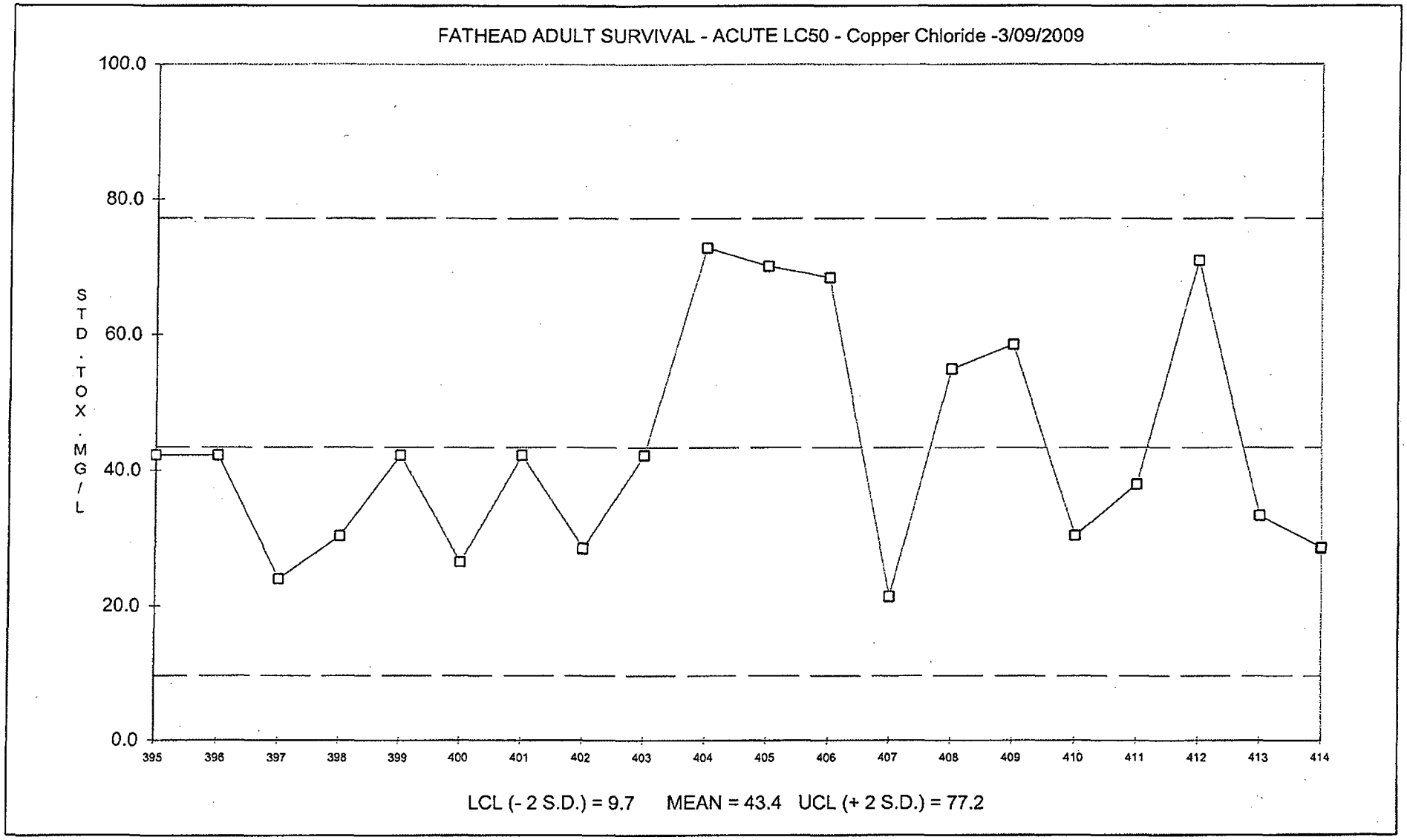
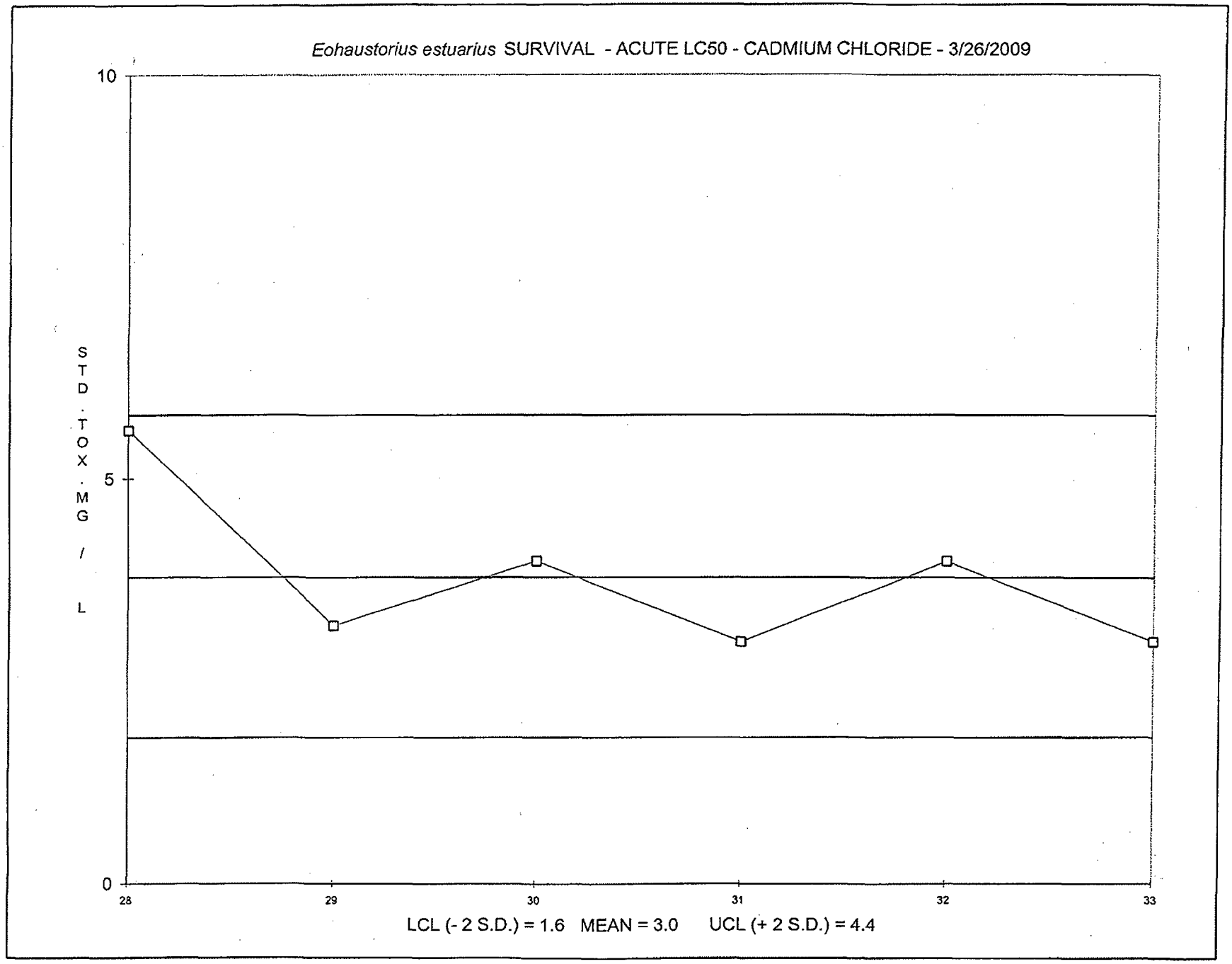

FATHEAD ADULT SURVIVAL - ACUTE LC50 - Copper Chloride -3/09/2009
100.0
80.0
60.0
40.0
20.0
0.0
STD.TOX.MG/L
395
396
397
398
399
400
401
402
403
404
405
406
407
408
409
410
411
412
413
414
LCL (- 2 S.D.) = 9.7
MEAN = 43.4
UCL (+ 2 S.D.) = 77.2

FIGURE 2-1. (CONTINUED).



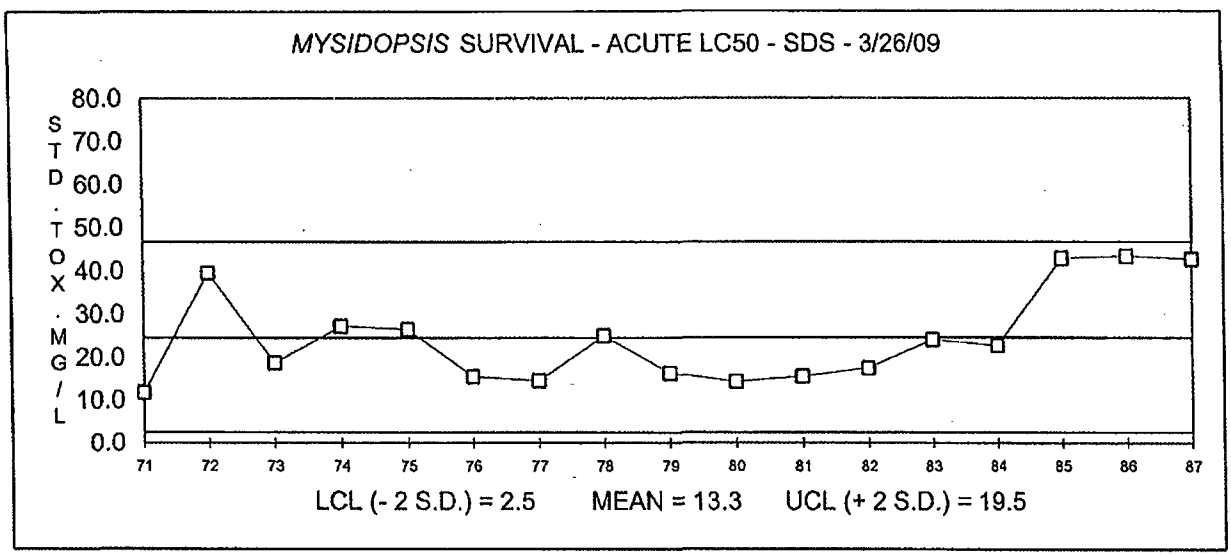

MYSIDOPSIS SURVIVAL - ACUTE LC50 - SDS - 3/26/09
STD. TOX. MG/L
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
LCL (- 2 S.D.) = 2.5
MEAN = 13.3
UCL (+ 2 S.D.) = 19.5

Table 7-2. CONTROL LIMIT EXCEEDENCE FORM

TEST _____ DATE _____

DESCRIBE OUT OF CONTROL INCIDENT _____

_____

_____

_____

DESCRIBE REASON FOR INCIDENT _____

_____

_____

_____

WHAT OTHER TESTS WERE AFFECTED? _____

_____

RECOMMENDATIONS _____

_____

_____

_____

Michael Machuzak, QC Officer Date

_____

Scott Johnson, Laboratory Director Date

7.4. INSTRUMENT CALIBRATION AND LOG-KEEPING TECHNIQUES

Holding water and animal conditions are monitored very closely. At a minimum of once per week, ammonia, salinity (for marine species). Temperature is checked in each holding tank daily. Also, a daily record of feeding, behavioural observations, and mortality are also maintained. Also weekly, tanks are cleaned of detritus and 50% of the water is changed. Dead or unhealthy looking organisms are always removed immediately.

Calibration, as defined at Aquatic Bioassay, involve those procedures that are performed routinely (daily or during every run of analysis) before any analyses are initiated (Table 7-4). Preventative maintenance involves those nonroutine procedures used to assure proper performance of laboratory equipment and instruments (Table 7-5). All calibration and maintenance procedures are dated, initialed, and recorded in a bound Laboratory Calibration Log.

7.5. INTERLABORATORY DMR AND SPLIT SAMPLE TESTING

Aquatic Bioassay is continuously involved in split sample and standard toxicant testing.

Aquatic Bioassay is an active member of the QA/QC Committee of the Southern California Toxicity Assessment Group (SCTAG).

Aquatic Bioassay is also involved in the annual DMR Studies for the EPA (see Appendix 9.4 for the most recent results) as well as the annual WP studies (see Appendix 9.4 for the most recent results).

7.6. STANDARD OPERATING PROCEDURES

Standard operating procedures for all requested bioassays are included in Appendix 9.5. Procedures are those specified in the published methods (See Table 5-1).

7.7. REPORTING

Data is acquistioned from laboratory bench sheets that test tecnicians have carefully prepared throughout the specific test by a senior technician. The bench sheets contain data that is specified in the EPA manuals and is also specified in each test SOP. The raw data is then entered into a computer to be analysed statistically by ToxCalc or SoftTox depending on the specific test. Once a data report is generated, it is inspected for completeness first by the technician preparing the report, secondly by the QC Officer and thirdly by the laboratory director. If the data report is correct and all acceptability criteria for the specific test have been met, it is signed by the Laboratory Director, copied and the original, with a wet signature, is dispatched to the client. A copy remains in our archives here at the laboratory.

If descrepancies are discovered at any of three levels of data examination, the Laboratory Director seeks the appropriate corrective action. This may include reanalysis of the data or a complete re-run of a particular toxicity test. After the corrective action has been carried out the same three tier examination of the final report takes place prior to releasing the data to the client.

Table 7-4. CALIBRATION PROCEDURES AND FREQUENCY.

PARAMETER	FREQUENCY	CALIBRATION PROCEDURE
Water System	Daily	Measure Conductivity and pH.
Thermometers	Monthly	Compare with N.B.S. standard.
Balances	With Each Use	Compare to Class S weights.
Oxygen Meter	Daily	Adjust zero, full scale, air calibration. Compare to Winkler titration.
Salinometer	Each use	Adjust redline. Compare to chloride titration standards.
Thermistors	Each use	Compare to N.B.S. traceable thermometers.
pH Meter	Daily	Calibrate to pH 7.0 and 4.0 or 10.0 buffers.
ISE Meter	Daily	Calibrate to standards curve.
Bioassay	Daily	Check temperature and Room continuous recorder.
Bioassay System	Daily	Check animal survival and water clarity.
Autoclave	Each run	Check spore tape and temperature.
Incubator	Daily	Check/adjust temperature.
Water Bath	Daily	Check/adjust temperature and water level.
Light Meter	Annually	Light meter is sent to manufacturer annually for factory calibration.

Table 7-5. PREVENTATIVE MAINTENANCE.

PARAMETER	FREQUENCY	MAINTENANCE	BY WHOM
Water System	As needed	Replace resin beds.	Mfgr.
Thermometers	As needed	Replace.	Staff
Balances	Annually	Service, calibrate.	Mfgr.
Oxygen Meter	As needed	Replace fill solution, membrane, batteries.	Staff
		Repair, service.	Mfgr.
Salinometer	As needed	Replate cond. probe. Replace batteries.	Staff
		Repair, service.	Mfgr.
Nephelometer	As needed	Cleaning, focusing, bulb replacement.	Staff
		Repair, service.	Mfgr.
Thermistors	As needed	Replace batteries.	Staff
		Repair, service.	Mfgr.
pH/ISE Meter	As needed	Clean probe.	Staff
		Repair, service.	Mfgr.
Bioassay	As needed	Change water. Clean tanks and filters.	Staff
Autoclave	Weekly	Clean outside and run with mild acid solution.	Staff
Incubator	As needed	Repair, service.	Mfgr.
Water Bath	As needed	Repair, service.	Mfgr.
Heating Oven	As needed	Repair, service.	Mfgr.

8. APPENDICES

8.1. EXAMPLES OF COMPLETED BIOASSAY REPORTS

AQUATIC
BIOASSAY &
CONSULTING
LABORATORIES, INC.

TOXICITY TESTING • OCEANOGRAPHIC RESEARCH

February 20, 2009

Client
City of California
222 Any Rd.
Anytown, CA 93000

Dear Client:

We are pleased to present the enclosed bioassay report. The test was conducted under guidelines prescribed in *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms EPA-821-R-02-013.* Results were as follows:

CLIENT:	City of California
SAMPLE I.D.:	EFF
DATE RECEIVED:	7 Feb - 09
ABC LAB. NO.:	THO0209.017

CHRONIC FATHEAD LARVAE SURVIVAL & GROWTH BIOASSAY

SURVIVAL	NOEC	=	100.00 %
	TUc	=	1.00
	IC25	=	>100.00 %
	IC50	=	>100.00 %
GROWTH	NOEC	=	100.00 %
	TUc	=	1.00
	IC25	=	>100.00 %
	IC50	=	>100.00 %

Yours very truly,
Scott C. Johnson

Scott C. Johnson
Laboratory Director

Larval Fish Growth and Survival Test-7 Day Survival

Start Date:	2/7/2009	Test ID:	XXX0209017	Sample ID:	CA0056294
End Date:	2/14/2009	Lab ID:	CAABC	Sample Type:	AMB1-Ambient water
Sample Date:	2/6/2009	Protocol:	EPA-821-R-02-013	Test Species:	PP-Pimephales promelas
Comments:	Eff				

Conc-%	1	2	3	4
N Control	1.0000	1.0000	1.0000	1.0000
32	0.9000	0.9000	1.0000	1.0000
42	0.9000	0.8000	0.9000	1.0000
56	0.9000	1.0000	0.9000	1.0000
75	1.0000	0.9000	1.0000	0.9000
100	1.0000	1.0000	1.0000	1.0000

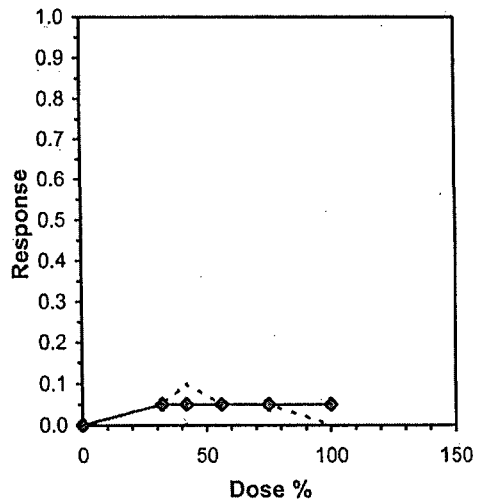
			Transform: Arcsin Square Root					Rank	1-Tailed	Isotonic	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical	Mean	N-Mean
N Control	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	4			1.0000	1.0000
32	0.9500	0.9500	1.3305	1.2490	1.4120	7.072	4	14.00	10.00	0.9500	0.9500
42	0.9000	0.9000	1.2543	1.1071	1.4120	9.935	4	12.00	10.00	0.9500	0.9500
56	0.9500	0.9500	1.3305	1.2490	1.4120	7.072	4	14.00	10.00	0.9500	0.9500
75	0.9500	0.9500	1.3305	1.2490	1.4120	7.072	4	14.00	10.00	0.9500	0.9500
100	1.0000	1.0000	1.4120	1.4120	1.4120	0.000	4	18.00	10.00	0.9500	0.9500

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.91208	0.884	0.08565	-0.406
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	100	>100		1
Treatments vs N Control				

Linear Interpolation (200 Resamples)

Point	%	SD	95% CL(Exp)	Skew
IC05	>100			
IC10	>100			
IC15	>100			
IC20	>100			
IC25	>100			
IC40	>100			
IC50	>100			



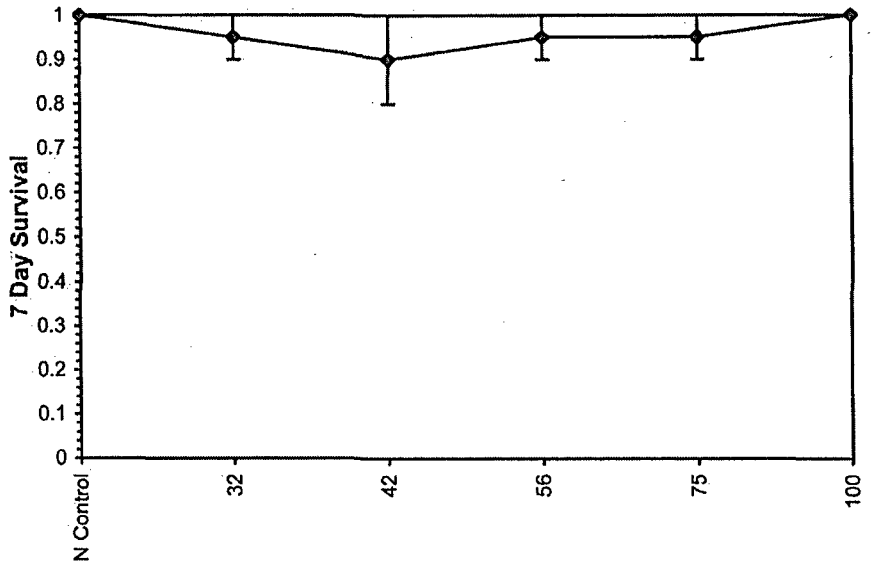
ToxCalc v5.0.23

Reviewed by:

Larval Fish Growth and Survival Test-7 Day Survival

Start Date:	2/7/2009	Test ID:	XXX0209017	Sample ID:	CA0056294
End Date:	2/14/2009	Lab ID:	CAABC	Sample Type:	AMB1-Ambient water
Sample Date:	2/6/2009	Protocol:	EPA-821-R-02-013	Test Species:	PP-Pimephales promelas
Comments:	Eff				

Dose-Response Plot



Larval Fish Growth and Survival Test-7 Day Biomass

Start Date:	2/7/2009	Test ID:	XXX0209017	Sample ID:	CA0056294
End Date:	2/14/2009	Lab ID:	CAABC	Sample Type:	AMB1-Ambient water
Sample Date:	2/6/2009	Protocol:	EPA-821-R-02-013	Test Species:	PP-Pimephales promelas
Comments:	Eff				

Conc-%	1	2	3	4
N Control	0.4380	0.3850	0.4420	0.3980
32	0.3240	0.4220	0.5260	0.4070
42	0.3700	0.2640	0.3660	0.4420
56	0.3690	0.4780	0.4850	0.4630
75	0.3500	0.2990	0.3860	0.4270
100	0.3240	0.3880	0.3680	0.4630

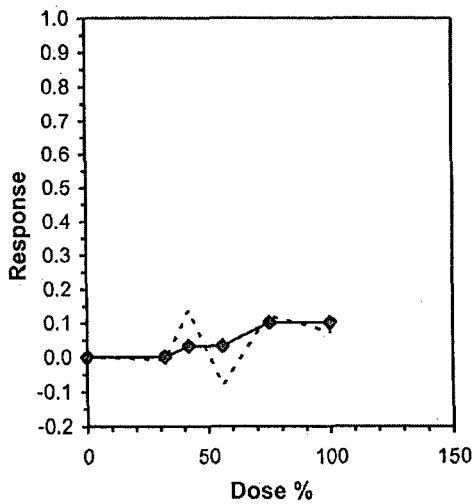
			Transform: Untransformed					1-Tailed			Isotonic	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
N Control	0.4158	1.0000	0.4158	0.3850	0.4420	6.866	4				0.4178	1.0000
32	0.4198	1.0096	0.4198	0.3240	0.5260	19.753	4	-0.093	2.410	0.1038	0.4178	1.0000
42	0.3605	0.8671	0.3605	0.2640	0.4420	20.305	4	1.282	2.410	0.1038	0.4046	0.9686
56	0.4488	1.0794	0.4488	0.3690	0.4850	12.023	4	-0.766	2.410	0.1038	0.4046	0.9686
75	0.3655	0.8791	0.3655	0.2990	0.4270	14.873	4	1.166	2.410	0.1038	0.3756	0.8992
100	0.3858	0.9278	0.3858	0.3240	0.4630	15.042	4	0.696	2.410	0.1038	0.3756	0.8992

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.96733	0.884	-0.094	-0.2837
Bartlett's Test indicates equal variances (p = 0.71)	2.93199	15.0863		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test Treatments vs N Control	100	>100		1	0.10385	0.24978	0.00477	0.00371	0.31335	5, 18

Linear Interpolation (200 Resamples)

Point	%	SD	95% CL(Exp)	Skew
IC05	61.086			
IC10	74.771			
IC15	>100			
IC20	>100			
IC25	>100			
IC40	>100			
IC50	>100			

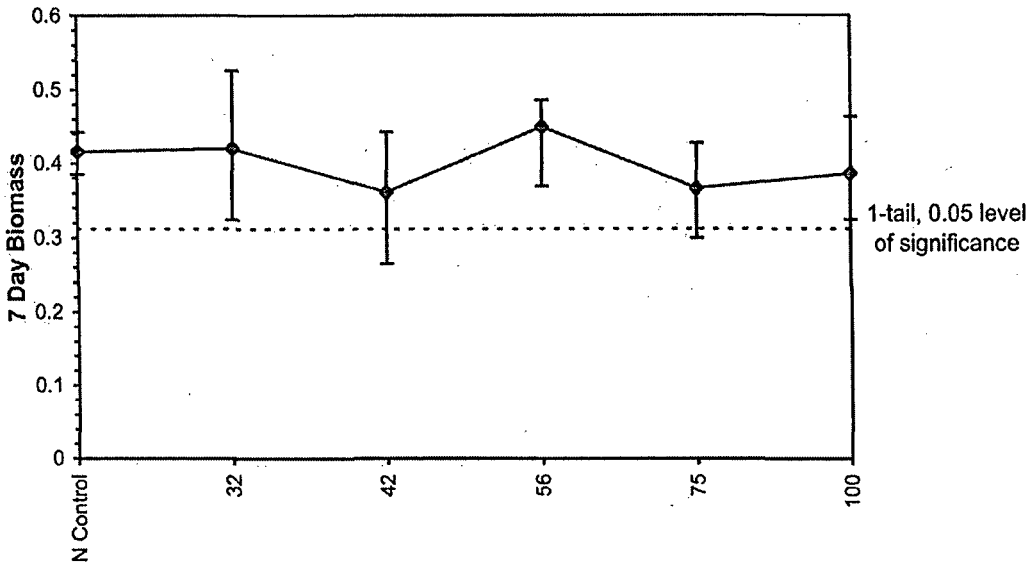


Reviewed by:

Larval Fish Growth and Survival Test-7 Day Biomass

Start Date:	2/7/2009	Test ID:	XXX0209017	Sample ID:	CA0056294
End Date:	2/14/2009	Lab ID:	CAABC	Sample Type:	AMB1-Ambient water
Sample Date:	2/6/2009	Protocol:	EPA-821-R-02-013	Test Species:	PP-Pimephales promelas
Comments:	Eff				

Dose-Response Plot



Reviewed by:

Larval Fish Growth and Survival Test-7 Day Biomass

Start Date:	2/7/2009	Test ID:	XXX0209017	Sample ID:	CA0056294
End Date:	2/14/2009	Lab ID:	CAABC	Sample Type:	AMB1-Ambient water
Sample Date:	2/6/2009	Protocol:	EPA-821-R-02-013	Test Species:	PP-Pimephales promelas
Comments:	Eff				

Auxiliary Data Summary

Conc-%	Parameter	Mean	Min	Max	SD	CV%	N
N Control	Temp C	24.30	24.00	24.90	0.32	2.33	8
32		24.60	24.00	25.20	0.54	2.99	8
42		24.64	24.00	25.20	0.55	3.00	8
56		24.69	24.00	25.30	0.59	3.10	8
75		24.76	24.00	25.50	0.65	3.26	8
100		24.85	24.00	25.60	0.73	3.44	8
N Control	pH	8.14	8.00	8.30	0.09	3.72	8
32		8.01	7.90	8.30	0.16	4.92	8
42		7.93	7.80	8.10	0.13	4.52	8
56		7.83	7.70	8.00	0.10	4.11	8
75		7.75	7.60	8.00	0.13	4.67	8
100		8.08	7.90	8.20	0.09	3.69	8
N Control	DO mg/L	7.63	6.70	7.90	0.42	8.47	8
32		7.79	5.90	9.10	0.89	12.13	8
42		7.44	5.90	8.30	0.83	12.25	8
56		7.75	7.50	8.30	0.27	6.74	8
75		7.61	5.70	9.30	1.52	16.19	8
100		7.65	5.70	8.80	0.89	12.35	8
N Control	Hardness mg/L	93.75	89.00	99.00	4.20	2.19	8
32		0.00	0.00	0.00	0.00		0
42		0.00	0.00	0.00	0.00		0
56		0.00	0.00	0.00	0.00		0
75		0.00	0.00	0.00	0.00		0
100		212.50	203.00	217.00	5.93	1.15	8
N Control	Alkalinity mg/L	305.00	286.00	344.00	17.07	1.35	8
32		562.38	465.00	766.00	98.15	1.76	8
42		545.38	519.00	588.00	25.07	0.92	8
56		626.38	603.00	642.00	15.92	0.64	8
75		739.88	719.00	755.00	13.17	0.49	8
100		898.75	886.00	919.00	13.22	0.40	8
N Control	Conductivity	62.38	60.00	65.00	2.07	2.30	8
32		0.00	0.00	0.00	0.00		0
42		0.00	0.00	0.00	0.00		0
56		0.00	0.00	0.00	0.00		0
75		0.00	0.00	0.00	0.00		0
100		144.25	141.00	146.00	2.19	1.03	8

AQUATIC BIOASSAY & CONSULTING
LABORATORIES, INC.

TOXICITY TESTING • OCEANOGRAPHIC RESEARCH

March 31, 2009

Client
City of California
222 Any Rd.
Anytown, CA 93000

Dear Client:

We are pleased to present the enclosed bioassay report. The test was conducted under guidelines prescribed in *Short-Term Methods for Measuring the Chronic Toxicity of Effluents and Receiving Waters to West Coast Marine and Estuarine Organisms, EPA/R-95/136.* Results were as follows:

CLIENT:	City of California
SAMPLE I.D.:	Plant Final Effluent
DATE RECEIVED:	3 March - 09
ABC LAB. NO.:	XXX0309.074

CHRONIC SEA URCHIN FERTILIZATION BIOASSAY

NOEC	=	5.60 %
TUc	=	17.86
IC25	=	>5.60 %
IC50	=	>5.60 %

Yours very truly,

Scott C. Johnson

Scott C. Johnson
Laboratory Director

29 NORTH OLIVE STREET, VENTURA, CA 93001 • (805) 643-5621

Sperm Cell Fertilization Test-Proportion Fertilized

Start Date:	3/3/2009	Test ID:	XXX0309074	Sample ID:	CA0048143
End Date:	3/3/2009	Lab ID:	CAABC	Sample Type:	EFF1-POTW
Sample Date:	3/3/2009	Protocol:	EPA600/R95/136, 1995	Test Species:	SP-Strongylocentrotus purpuratus
Comments:	Plant Final Effluent				

Conc-%	1	2	3	4
N Control	1.0000	1.0000	1.0000	1.0000
0.56	1.0000	1.0000	1.0000	1.0000
1	1.0000	1.0000	1.0000	1.0000
1.8	1.0000	0.9800	1.0000	1.0000
3.2	1.0000	1.0000	1.0000	1.0000
5.6	1.0000	1.0000	1.0000	1.0000

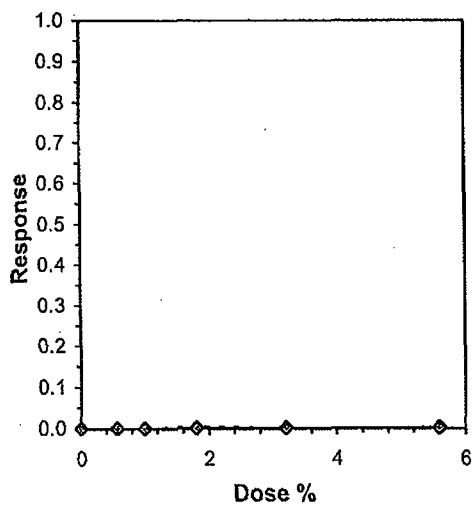
			Transform: Arcsin Square Root					Rank	1-Tailed	Isotonic	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical	Mean	N-Mean
N Control	1.0000	1.0000	1.5208	1.5208	1.5208	0.000	4			1.0000	1.0000
0.56	1.0000	1.0000	1.5208	1.5208	1.5208	0.000	4	18.00	10.00	1.0000	1.0000
1	1.0000	1.0000	1.5208	1.5208	1.5208	0.000	4	18.00	10.00	1.0000	1.0000
1.8	0.9950	0.9950	1.4978	1.4289	1.5208	3.067	4	16.00	10.00	0.9983	0.9983
3.2	1.0000	1.0000	1.5208	1.5208	1.5208	0.000	4	18.00	10.00	0.9983	0.9983
5.6	1.0000	1.0000	1.5208	1.5208	1.5208	0.000	4	18.00	10.00	0.9983	0.9983

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.46508	0.884	-3.0206	13.9892
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	5.6	>5.6		17.8571
Treatments vs N Control				

Linear Interpolation (200 Resamples)

Point	%	SD	95% CL(Exp)	Skew
IC05	>5.6			
IC10	>5.6			
IC15	>5.6			
IC20	>5.6			
IC25	>5.6			
IC40	>5.6			
IC50	>5.6			

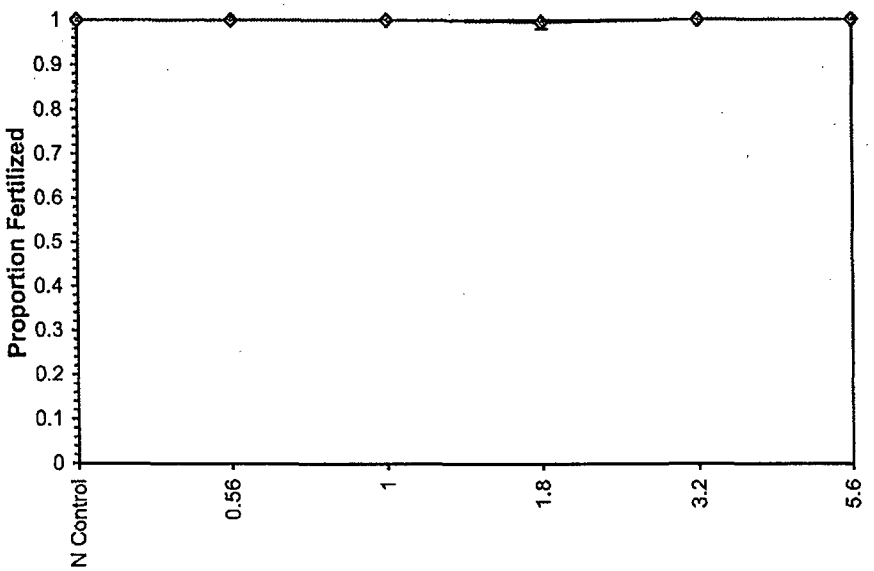


Reviewed by:

Sperm Cell Fertilization Test-Proportion Fertilized

Start Date:	3/3/2009	Test ID:	XXX0309074	Sample ID:	CA0048143
End Date:	3/3/2009	Lab ID:	CAABC	Sample Type:	EFF1-POTW
Sample Date:	3/3/2009	Protocol:	EPA600/R95/136, 1995	Test Species:	SP-Strongylocentrotus purpuratus
Comments:	Plant Final Effluent				

Dose-Response Plot



Reviewed by:

Sperm Cell Fertilization Test-Proportion Fertilized

Start Date:	3/3/2009	Test ID:	XXX0309074	Sample ID:	CA0048143
End Date:	3/3/2009	Lab ID:	CAABC	Sample Type:	EFF1-POTW
Sample Date:	3/3/2009	Protocol:	EPA600/R95/136, 1995	Test Species:	SP-Strongylocentrotus purpuratus
Comments:	Plant Final Effluent				

Auxiliary Data Summary

Conc-%	Parameter	Mean	Min	Max	SD	CV%	N
N Control	Temp C	15.20	15.20	15.20	0.00	0.00	2
0.56		15.20	15.20	15.20	0.00	0.00	2
1		15.20	15.20	15.20	0.00	0.00	2
1.8		15.20	15.20	15.20	0.00	0.00	2
3.2		15.20	15.20	15.20	0.00	0.00	2
5.6		15.20	15.20	15.20	0.00	0.00	2
N Control	pH	8.00	8.00	8.00	0.00	0.00	2
0.56		8.00	8.00	8.00	0.00	0.00	2
1		8.00	8.00	8.00	0.00	0.00	2
1.8		8.00	8.00	8.00	0.00	0.00	2
3.2		8.00	8.00	8.00	0.00	0.00	2
5.6		8.00	8.00	8.00	0.00	0.00	2
N Control	DO mg/L	7.60	7.60	7.60	0.00	0.00	2
0.56		7.10	7.10	7.10	0.00	0.00	2
1		7.00	7.00	7.00	0.00	0.00	2
1.8		7.00	7.00	7.00	0.00	0.00	2
3.2		6.80	6.80	6.80	0.00	0.00	2
5.6		6.70	6.70	6.70	0.00	0.00	2
N Control	Salinity ppt	34.00	34.00	34.00	0.00	0.00	2
0.56		34.00	34.00	34.00	0.00	0.00	2
1		34.00	34.00	34.00	0.00	0.00	2
1.8		34.00	34.00	34.00	0.00	0.00	2
3.2		33.00	33.00	33.00	0.00	0.00	2
5.6		32.00	32.00	32.00	0.00	0.00	2

APPENDIX 8.2. RESUMES OF KEY PERSONNEL

SCOTT C. JOHNSON

CORE COMPETENCIES:

- Laboratory Management - Managed all facets of the City of Los Angeles' Santa Monica Bay and Los Angeles River NPDES monitoring programs including water quality, benthic ecology, toxicity testing, reporting and permit negotiations.
- Project Management Managed the scheduling, budgeting, resource allocation, risk analysis, customer communications and conflict management for projects ranging from the environmental to software business areas.
- Technical Management - Lead teams composed of programmers, DBAs, statisticians, ecologists, and technical writers.
- Executive Management - Responsible for business planning/ market sbategy, human resources, and finances.
- Presentation Skills - Skilled at scientific presentation, group facilitation, software demonstrations and training seminars.
- Proposals - Strategy and team development, pricing, writing, and contract negotiation.
- Science - Background includes laboratory and field biology, chemistry and statistics.

EMPLOYMENT HISTORY&. EXPERIENCE:

Aquatic Bioassay&. Consulting Laboratories, Ventura CA
Laboratory Director, Director of Aquatic Operations &. Environmental Consulting - January 2002 to present
Mr. Johnson is responsible for all ocean and freshwater monitoring and laboratory operations, environmental assessments, reporting and marine consulting. He is responsible for the NPDES marine monitoring programs for the largest municipal dischargers on the central California coast including the cities of Oxnard, Goleta, Santa Barbara, Avalon and San Luis Obispo.
Other monitoring programs he is either responsible for or providing services to include the ongoing Marina del Rey TMDL survey, the Ventura River Assessment Program, Lake Elsinor monitoring program and the Haiwee Reservoir study. Mr. Johnson ensures that all field and laboratory operations are conducted with strict adherence to the proper protocols and that all results and reports are provided to the client in an accurate and timely fashion.

eLabor. Camarillo. CA
Vice President, Professional Services - October 1999 to January 2002
As Vice President in charge of the Professional Services Division, reporting directly to the CEO, Mr. Johnson was responsible for a staff composed of 50 employees mandated with the implementation and support of a workforce management product suite delivered as either a hosted (ASP) or premise based solution. His primary responsibilities include all divisional budgeting, P&L, human resources, strategic partners and customer relationships.

Director, Project Services - February 1999 to October 1999
As Director Mr. Johnson managed a team of project managers who were responsible for the successful implementation of client server database applications to Fortune 500 clients. My responsibilities included managing client relationships, company-wide revenue and resource forecasting, day-to-day project management operations such as scheduling, budgeting and resource allocations, project costing and technical sales. Additionally, I helped to establish the roles and responsibilities of the Director level position and worked with the executive management team to solve operational problems faced by this quickly growing company.

JTS, Oiai. CA
Owner - October 1998 to June 1999
As a sole proprietor I provided Independent consulting services to both private and government agencies in need of database and web site development, data synthesis, project management and technical writing.

EcoAnalysis, Inc., Oiai. CA
President. 1996 to October 1998 .
EcoAnalysis was an information and consulting services company composed of professional programmers, ecologists and managers specializing in information synthesis and the development of client server information management systems for the environmental industry.
Mr. Johnson was promoted to President by the Board of Directors to guide a restructuring process in 1997 that included:
defining the company vision, development of a detailed business plan that refocused the company and resulting in the development of 3 'core' software applications, expanded sales and marketing efforts nationwide, initiated negotiations for partnerships/acquisitions with several large environmental engineering firms/ and refinanced/restructured debt/loans.
He built relationships with targeted potential clients, strategic partners, and investment bankers; reviewed company cash flow, income and balance sheet reports; was responsible for hiring technical, management and support personnel;
and lead the marketing and sales effort including strategic planning, proposal planning, advertising and presentations.

EcoAnalysis, Inc. (continued)

Division Management. 1994 to 1996 .

Initially hired as the Director of the TOXIS product line (a toxicity testing database and analysis tool), Mr. Johnson was promoted to Division Manager of the Environmental Consulting Division.

In 1995 he was asked to lead the Information Management Division where his responsibilities included: leading the daily project related operations of the programming teams, statisticians and ecologists; personnel hiring, operations budgets and P&ls; initiation of marketing efforts and the generation of proposals.

Project Experience - 1994 to 1998 .

Mr. Johnson managed the development of several large, client-server database systems for federal, state and municipal agencies that were striving to meet EPA regulatory standards.

His key strength is the management of technical and political issues that arise between project team members, the client and their regulatory agencies. On several occasions he assisted to facilitate compromise solutions between several separate technical groups within agencies to ensure project success.

He was responsible for ensuring successful project completion through aggressive management of staff schedules, milestones, resource allocation, implementation strategies, data model and application development, interfacing between the client and programmers, and contract disputes and resolutions.

City of Los Angeles, Los Angeles, CA

Laboratory Manager - 1992 to 1994
Laboratory Supervisor -1988 to 1992
Water Biologist - 1984 to 1988

As Laboratory Manager and Supervisor Mr. Johnson was in charge of the City of Los Angeles' NPDES ocean monitoring program for Santa Monica Bay that included administration of an annual budget and management of 33 professional staff.

The program was designed to assess the impacts of effluent emanating from the City's Hyperion Treatment Plant (420 MGD) on the water quality and biota of Santa Monica Bay. Mr. Johnson was responsible for assuring the timely and accurate completion of all NPDES ocean monitoring programs and reporting including:

bacteriology, benthic infauna and trawling, rig fishing, seafood consumption, water quality, chronic and acute bioassays and microlayer.

Other responsibilities included: Senior Editor of the Santa Monica Bay Annual Assessments Report, management of NPDES negotiations for the Hyperion Treatment Plants with the EPA and state regional board direct communications with the Department of Health Services and other agencies regarding bathing water standards and swimming safety in Santa Monica Bay . Mr. Johnson was Chairperson of the Southern California Toxicity Testing Association's Policy Committee (1990 to 1995).

As a Water Biologist, Mr. Johnson was responsible for the Los Angeles River monitoring program and participation in all facets of the Santa Monica Bay ocean monitoring program.

County Sanitation Districts of Los Angeles. Whittier. CA
Laboratory Technician - 1982 to 1984

As Laboratory Technician, Mr. Johnson participated in all facets of the Sanitation District's marine monitoring programs including benthic infauna, trawling, water quality, bacteriology, data entry and quality assurance.

EDUCATION

M.S. Biology, California State University, Long Beach - 1988
B.A. Biology, Minor Chemistry, California State University, Long Beach – 1981
Limnology Program, University Uppsala, Sweden - 1979

THOMAS (TIM) MIKEL
Senior Scientist

PROFESSIONAL BACKGROUND

AQUATIC BIOASSAY AND CONSULTING LABORATORIES
Laboratory President (1988 to Present)

Experienced with regional, state, and federal environmental agencies. Specialist in statistical evaluation of environmental data. Joint Chair for Mollusk Section of 20th Edition of *Standard Methods*. Chair of Methods Committee for Southern California Toxicity Assessment Group (SCTAG). Co-chair of the 1998 Southern California Bight Pilot Project Toxiciy Committee. Board Member of Southern California Society of Environmental Toxicology and Chemistry.

CHEMICAL RESEARCH LABORATORIES
Laboratory Director (1985 to 1988)

Director of 35 scientists and staff of a complete environmental bioassay, chemistry, bacteriology, and ocean monitoring laboratory. Designer and author of several new bioassay techniques. Frequent guest speaker for numerous environmental health agencies. Project manager for City of Oxnard, Chevron USA, and THUMS Long Beach ocean monitoring projects.

JACOBS ENVIRONMENTAL
Laboratory Director (1976 to 1985)

Director of Jacobs Ventura environmental laboratory. Designer of the Ecological Restoration Project of Upper Newport Bay. Developed hazardous waste bioassay and chemical analysis laboratories at this location. Responsible for all freshwater and marine NPDES bioassays. Project manager of all receiving water monitoring projects.

VENTURA COLLEGE
Oceanography Instructor (1978 to 1979)

Instructor for physical, chemical, and biological oceanography.

SANTA BARBARA UNDERSEAS FOUNDATION
Assistant Director (1974 to 1975)

Chief marine biologist for the Anacapa Island Underwater Nature Trail in cooperation with the U.S. National Park Service.

U.S. DEPARTMENT OF THE INTERIOR
Marine Biologist (1973 to 1974)

Chief marine biologist for intertidal surveys conducted near Big Sur, California. Served as chief biological consultant for team of professional archaeologists.

ACADEMIC BACKGROUND

M.A. 1975. Population and Aquatic Biology. University of California, Santa Barbara.

B.A. 1973. Marine Biology, California State University, Moss Landing Marine Laboratories.

PROFESSIONAL SOCIETIES

Southern California Academy of Sciences

Society of Environmental Toxicity and Chemistry. Board Member, Southern California Chapter.

***Standard Methods*, Joint Task Group Chair for 20th Edition (1996), Section 8610 - Molluscan Bioassays.**

Southern California Bight Pilot Project – Toxicity Subcommittee Co-Chair.

Southern California Toxicology Assessment Group (SCTAG), Chair of the Methods Committee (since 1993)

Southern California Association of Marine Invertebrate Taxonomists (SCAMIT).

PUBLICATIONS

"The prevalence of non-indigenous species in southern California embayments and their effects on benthic macroinvertebrate communities" (in press). Southern California Coastal Water Research Project – Annual Report 2002 (with D. Montagne, R. Velarde, J. Ranasinghe, S. Weisberg, R. Smith, and A. Dalkey).

"Southern California Bight 1998 Regional Monitoring Program. Water Quality" (in prep.) Southern California Coastal Water Research Project (with J. Ranasinghe, D. Montagne, R. Smith, S. Weisberg, D. Cadien, R. Velarde, and A. Dalkey).

"Southern California Bight 1998 Regional Monitoring Program: VII. Benthic Macrofauna" 2002. Southern California Coastal Water Research Project (with J. Ranasinghe, D. Montagne, R. Smith, S. Weisberg, D. Cadien, R. Velarde, and A. Dalkey).

"Southern California Bight 1998 Regional Monitoring Program: I. Executive Summary" (in press). Southern California Coastal Water Research Project (with J. Ranasinghe, D. Montagne, S. Weisberg, S. Bay, M. Allen, J. Noblet, and B. Jones).

"Southern California Bight 1998 Regional Monitoring Program: V. Demersal Fishes and Megabenthic Invertebrates" 2002. Southern California Coastal Water Research Project (with M. Allen, A. Groce, D. Diener, J. Brown, S. Steinert, G. Deets, J. Noblet, S. Moore, D. Diehl, E. Jarvis, V. Raco-Rands, C. Thomas, Y. Ralph, R. Gartman, D. Cadien, and S. Weisberg).

"Southern California Bight 1998 Regional Monitoring Program: IV. Sediment Toxicity" 2000. Southern California Coastal Water Research Project (with S.Bay, D. Lapota, J. Anderson, J. Armstrong, A. Jirik, and S. Asato).

"Southern California Marine Monitoring Standard Data Transfer Formats" 2000. Southern California Coastal Water Research Project (with L. Cooper, S. Weisberg, D. Montagne, S. Walther, K. Walker, J. Shisko, I. Lee, S. Moore, G. Ferreri, P. Smith, R. Fairey, S. Chang, A. Soof, C. Roberts, M. Mengel, R. Wang, F. Lecaro, M. Emanuel, D. O'Donahue, G. Alfonso, M. Kelly, S. Meyer, L. King, R. Gossett, and H. Ngyyen).

"Molluscan Bioassays", Section 8610, *Standard Methods,* 20th Edition 1996.

"Marine Chronic Toxicity: Test of Effluent Quality from an Orange County Wastewater Treatment Plant." 1996. Society of Enironmental Toxicology and Chemistry (SETAC) Annual Meeting. Washington D.C. (with Tom Gerlinger). Submitted for publication.

"Drilling Fluid Bioassays Using Pacific Ocean Mysid Shrimp, Acanthomysis sculpta, a Preliminary Introduction." Aquatic Toxicology and Hazard Assessment: 10th Vol. ASTM STP 971. American Society of Testing and Materials. 1988 (with Michael Machuzak).

"The California Assessment Manual: Determination of Hazardous Wastes." 1985. California Water Pollution Control Federation Journal.

"Ecological Restoration Project of Upper Newport Bay." 1977. U.S. Environmental Protection Agency.

"Marine Wastewater Outfalls as Artificial Reefs." 1985. Bulletin of Marine Sciences.

PRESENTATIONS

"The Relationship Between Individual and Taxa Counts of Benthic Infauna From Southern California Bight Harbors." 2002 Southern California Society of Environmental Toxicology and Chemistry, Annual Meeting.

"Diversity-Abundance Relationships in Benthic Habitats of the Southern California Bight." 2002. Southern California Academy of Sciences Annual Meeting.

"Benthic Sediment Surveys of Haiwee Reservoir." 2001 Southern California Society of Environmental Toxicology and Chemistry, Annual Meeting.

"Sediment Toxicity in the Southern California Bight Using Marine Amphipods." 2000. Southern California Society of Environmental Toxicology and Chemistry, Annual Meeting.

"Marine Chronic Toxicity: Test of Effluent Quality from an Orange County Wastewater Treatment Plant." 1996. Society of Environmental Toxicology and Chemistry (SETAC) Annual Meeting. Washington D.C. (with Tom Gerlinger).

Afternoon Session Chair. 1995. Southern California Toxicity Assessment Group (SCTAG), Annual Meeting and Toxicity Workshop.

Afternoon Session Chair. 1994. Southern California Toxicity Assessment Group (SCTAG), Annual Meeting and Statistics Workshop.

"Experiments with Organic Buffers and Pure Oxygen for Ammonia Conversion in Acute Municipal Wastewater Bioassays." 1993. Southern California Toxicity Assessment Group (SCTAG). Annual Meeting.

"Chronic Toxicity Tests Using *Ceriodaphnia dubia* and Interpretation of Test Results Using "Toxstat"." 1992. Santa Ana Regional Water Quality Control Board and University of California, Riverside Extension.

"An Aquatic Bioassay Primer." 1992. California Water Pollution Control Association.

"Toxicity Testing - Acute and Chronic Bioassays." 1991. California Water Pollution Control Association.

"Chemical and Biological Analysis of Hazardous Waste." 1987. Hazardous Materials Conference. Ventura County Environmental Health Department.

"Sediment Bioassays Using Mysid Shrimp." 1985. 10th Annual Aquatic Toxicity Symposium. American Society for Testing and Materials (ASTM).

"Determination of Hazardous Waste by Biological and Chemical Methods." 1985. Hazardous Waste Compliance Workshop. Ventura County Environmental Health Department.

"Marine Wastewater Outfalls as Artificial Reefs." 1983. Third International Artificial Reef Conference.

AWARDS AND HONORS

American Men and Women in Science. 1986 to Present.

Who's Who in America. 1996 to Present.

University of California Research Grant. 1975.

SPECIAL FIELDS OF KNOWLEDGE

Infaunal Ecology and Toxicity of of Harbor and Coastal Benthos

Statistical Evaluation of Environmental Data.

Oceanographic Sampling and Analysis, Marine Invertebrate Taxonomy.

Acute and Chronic, Freshwater and Marine Bioassays: Testing and Development.

MICHAEL J. MACHUZAK
Senior Scientist

PROFESSIONAL BACKGROUND

AQUATIC BIOASSAY AND CONSULTING LABORATORIES Assistant Laboratory Director (1996 to Present)

Responsible for chronic and acute, freshwater and marine bioassays; as well oceanographic field work at Aquatic Bioassay. Responsible for bioassay report preparation, set-up and analysis, client interface, and quality control. Mr. Machuzak is a member of the Bight 2008 Toxicity and Field Methods committees.

AB LAB AQUACULTURE INDUSTRIES, INC. Director (1988 to 1996)

Responsible for the quality control, collection, maintenance, production, and shipping of live commercial abalone. Design and maintained grow-out facilities in Oxnard and Port Hueneme, California.

CHEMICAL RESEARCH LABORATORIES Chief Marine Biologist (1985 to 1986)

Supervisor of the Biology Department involving bioassays, microbiology, benthic taxonomy and oceanographic research surveys. Responsible for the quality control of the marine research and bioassay programs. Involved in client contact and interface with California and Federal regulatory agencies.

ACADEMIC BACKGROUND

1981. Biology. Eastern Kentucky University.

PROFESSIONAL SOCIETIES

Southern California Toxicology Assessment Group (SCTAG). Methods, QNQC, and Policy Subcommittees.

Southern California Environmental Chemists Society (SCECS).

American Society of Testing and Materials (ASTM).

Southern California Chapter of the Society of Environmental Toxicologists and Chemists (SETAC)

PUBLICATIONS

"Drilling Fluid Bioassays Using Pacific Ocean Mysid Shrimp, *Acanthomysis sculpta,* a Preliminary Introduction." Aquatic Toxicology and Hazard Assessment: 10th Vol. ASTM STP 971. American Society of Testing and Materials. 1988 (with Thomas Mikel).

"Observations of Growth Responses on Red Abalone, *Haliotus rufescens* When Subjected to Various Types of Natural, Non-Marine and Artificial Diets." Second International Symposium on Abalone Biology, Fisheries Culture, February 1994.

SPECIAL FIELDS OF KNOWLEDGE

Acute and Chronic, Freshwater and Marine Bioassays.

Oceanographic Sampling and Analysis.

Environmental Chemical and Bacteriological Testing.

Quality Control

Karin J. Wisenbaker
Marine Biologist

MS. WISENBAKER IS A MARINE BIOLOGIST WITH AQUATIC BIOASSAY AND CONSULTING LABORATORIES IN VENTURA, CA. AT AQUATIC BIOASSAY SHE IS THE FIELD MANAGER OF BOTH THE FRESHWATER BIOASSESSMENT AND MARINE MONITORING PROGRAMS FOR CLIENTS WHO REPRESENT SOME OF THE LARGEST STATE AND MUNICIPAL AGENCIES IN SOUTHERN CALIFORNIA. HER PRIMARY AREAS OF FOCUS INCLUDE MARINE AND FRESHWATER ECOLOGY, DATA MANAGEMENT AND REPORTING.

AQUATIC BIOASSAY & CONSULTING LABORATORIES INC.

PROJECT EXPERIENCE:

Marine Monitoring – Ms. Wisenbaker is the field manager of the marine monitoring programs for several central and southern California agencies including the Goleta Sanitary District, the Cities of Oxnard, San Luis Obispo, Santa Barbara, Montecito, Summerland, Avalon and Carpentaria, and the Los Angeles Department of Beaches and Harbors. These programs include sampling and analysis for ichthyoplankton, water quality, sediment chemistry and toxicity, bioaccumulation, trawled organisms, benthic infauna, and microbiology. For each of these programs, Ms. Wisenbaker is responsible for equipment maintenance, field mobilization, and data management. Ms. Wisenbaker also manages Aquatic Bioassay's infauna sorting laboratory. Ms. Wisenbaker began her career with the Southern California Marine Institute where she was the Environmental Projects Coordinator.

Freshwater Bioassessment Monitoring – Ms. Wisenbaker is the field manager responsible for coordinating and mobilizing bioassessment monitoring for three of southern California's largest ambient watershed monitoring programs and numerous NPDES point source discharge agencies. Some of these include the Ventura, Riverside and Malibu Watershed Protection Agencies, and the Cities of Ventura, Camarillo, Simi Valley, Moorepark and the Newhall Land and Farming Company.

EMPLOYMENT HISTORY & EXPERIENCE:

<u>Aquatic Bioassay & Consulting Laboratories, Ventura CA</u>

Marine Biologist – September 2003 to present

Ms. Wisenbaker is responsible for the mobilization and sampling of ocean and freshwater monitoring, data management as well as managing the infauna and benthic macroinvertebrate sorting laboratory. She is responsible for mobilizing the field work of freshwater bioassessment and marine monitoring programs for some of the largest agencies in southern California including the Los Angeles Department of Water and Power, the Los Angeles Department of Beaches and Harbors, the Ventura County Watershed District, the Santa Ana Regional Water Quality Control Board, the State of California's Contaminated Sediments Task Force, the City of Oxnard, the Goleta Sanitary District, the City of Santa Barbara, the City of Avalon and the City of San Luis Obispo. Ms. Wisenbaker ensures all the field sampling gear is in good condition and that field and laboratory operations are conducted with strict adherence to the proper protocols.

<u>Southern California Marine Institute, Terminal Island CA</u>

Environmental Projects Coordinator – September 2001 to August 2003

As Environmental Projects Coordinator, Ms. Wisenbaker was a citizen water quality monitoring coordinator. Her responsibilities included water quality training, education,

the development of quality assurance protocols, data management and report writing. Ms. Wisenbaker wrote and implemented grants for water quality studies and collected and reported oceanographic data off of volunteer observation ships for the National Oceanic & Atmospheric Administration.

Instructional Technician – March 1994 – August 2001

Ms. Wisenbaker taught students from 4th grade to college onboard three scientific research vessels. Her responsibilities included teaching of the local marine flora and fauna and to demonstrate the use of scientific gear such as otter trawls, CTD, van Veen grabs, and plankton nets. Ms. Wisenbaker was also an on board technician during scientific research trips with researchers from universities and consulting firms. She was responsible for the maintenance of all on board scientific gear.

EDUCATION

B.S. Biology, California State University, Northridge - 2000

PROFESSIONAL AFFILIATIONS

- Southern California Chapter of the Society of Environmental Toxicologist and Chemists (SETAC)
- Member Southern California Association of Marine Invertebrate Taxonomists (SCAMIT)
- Member Southern California Academy of Sciences (SCAS)

Beth Maturino
Lead Technician

PROFESSIONAL BACKGROUND

AQUATIC BIOASSAY AND CONSULTING LABORATORIES
Aquatic Biologist (1994 to Present)

Responsible for chronic and acute, freshwater and marine bioassays at Aquatic Bioassay. Responsible for bioassay report preparation, set-up and analysis, client interface, and quality control. Responsible for bacteriological analysis of receiving water samples as well as bacteriological QA/QC.

ACADEMIC BACKGROUND

Technical training, Biology. St. Luis University Bagiou City, Phillipines

SPECIAL FIELDS OF KNOWLEDGE

Acute and Chronic, Freshwater and Marine Bioassays.

Sediment Bioassays.

Environmental Chemical and Bacteriological Testing.

Health and Maintenance of Marine and Freshwater Bioassay Organisms.

Joseph Freas
Lead Technician

PROFESSIONAL BACKGROUND

AQUATIC BIOASSAY AND CONSULTING LABORATORIES
Aquatic Biologist (July 2006 to Present)

Responsible for chronic and acute, freshwater and marine bioassays at Aquatic Bioassay. Responsible for bioassay report preparation, set-up and analysis, client interface, and quality control.

ACADEMIC BACKGROUND

B.S. 2006. Biology. California State University Channel Islands

SPECIAL FIELDS OF KNOWLEDGE

Acute and Chronic, Freshwater and Marine Bioassays.

Freshwater and Marine sediment toxicity bioassays.

Data analysis and report preparation.

Health and Maintenance of Marine and Freshwater Bioassay Organisms.

APPENDIX 8.3. EXAMPLE OF A CHRONIC BIOASSY WORKSHEET

CHEMICAL ANALYSIS DATA SHEET-_____

Start Date: _____ Lab#: _____

End Date: _____ Date Rec'd: _____

Renewal Sample Used:

DAY	0	1	2	3	4	5	6	7
Initials								
DISSOLVED OXYGEN mg/L								
CONTROL								
TEMPERATURE °C								
CONTROL								
pH								
CONTROL								
CONDUCTIVITY umohs								
CONTROL								
ALKALINITY								
CONTROL								
100%								
HARDNESS								
CONTROL								
100%								

Residual Chlorine 1st Sample_____ 2nd Sample_____ 3rd Sample_____

CERIODAPHNIA SURVIVAL & REPRODUCTION -

Aquatic Bioassay & Consulting Laboratories, Inc.

START DATE:_____ LAB #: _____

END DATE: _____ DATE RECD:_____

Conc.	Day#	Initials	# YOUNG / REPLICATE									
			1	2	3	4	5	6	7	8	9	10
CON	3											
	4											
	5											
	6											
	7											
	Total											
10%	3	-										
	4	-										
	5	-										
	6	-										
	7	-										
		-										
	Total	-										
18%	3	-										
	4	-										
	5	-										
	6	-										
	7	-										
		-										
	Total	-										
32%	3	-										
	4	-										
	5	-										
	6	-										
	7	-										
		-										
	Total	-										
56%	3	-										
	4	-										
	5	-										
	6	-										
	7	-										
		-										
	Total	-										
100%	3	-										
	4	-										
	5	-										
	6	-										
	7	-										
		-										
	Total	-										

Used Neonates ____/____/____ 0800-1600 Brood Board #:_____

ABC LABORATORIES – FATHEAD MINNOW GROWTH

Company: ______________________ Lab #: ______________

Sample I.D.: ______________________ Rec'd. Dates: ______________

Date & Time Start: ______________________ ______________

Date & Time End: ______________________ ______________

Conc.	Rep.#	INITIAL	1	2	3	4	5	6	FINAL
CONTROL	1	15							
	2	15							
	3	15							
	4	15							
	1	15							
	2	15							
	3	15							
	4	15							
	1	15							
	2	15							
	3	15							
	4	15							
	1	15							
	2	15							
	3	15							
	4	15							
	1	15							
	2	15							
	3	15							
	4	15							
	1	15							
	2	15							
	3	15							
	4	15							

CHAMBER NUMBER	EFF. CONC.	REPL. #	NUMBER FISH	BOAT TARE	BOAT + FISH	FISH WEIGHT (g)	AVG. WT. PER FISH (g)
	CONTROL	1					
		2					
		3					
		4					
		1					
		2					
		3					
		4					
		1					
		2					
		3					
		4					
		1					
		2					
		3					
		4					
		1					
		2					
		3					
		4					
		1					
		2					
		3					
		4					

APPENDIX 8.4. DOHS LABORATORY CERTIFICATION

CDPH
PublicHealth

STATE OF CALIFORNIA
DEPARTMENT OF PUBLIC HEALTH
ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

ENVIRONMENTAL LABORATORY CERTIFICATION

Is hereby granted to

AQUATIC BIOASSAY & CONSULTING LABORATORIES, INC.

29 NORTH OLIVE STREET
VENTURA, CA 93001

Scope of certification is limited to the
"Accredited Fields of Testing"
which accompanies this Certificate.

Continued certification status depends on successful completion of site visit, proficiency testing studies, and payment of applicable fees.

This Certificate is granted in accordance with provisions of Section 100825, et seq. of the Health and Safety Code.

Certificate No.: **1907**

Expiration Date: **07/31/2009**

Effective Date: **07/01/2007**

Richmond, California
subject to forfeiture or revocation

George C. Kulasingam, Ph.D.
Program Chief
Environmental Laboratory Accreditation Program

CALIFORNIA DEPARTMENT OF HEALTH SERVICES
ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM
Accredited Fields of Testing

AQUATIC BIOASSAY & CONSULTING LABORATORIES, INC. Lab Phone (805) 643-5621

29 NORTH OLIVE STREET
VENTURA, CA 93001

Certificate No: 1907 **Renew Date: 07/31/2007**

Field of Testing: 107 - Microbiology of Wastewater			
107.020	001	Total Coliform	SM9221B
107.040	001	Fecal Coliform	SM9221C,E (MTF/EC)
107.100	001	Fecal Streptococci	SM9230B
107.100	002	Enterococci	SM9230B
Field of Testing: 108 - Inorganic Chemistry of Wastewater			
108.050	001	pH	EPA 150.1
108.251	001	Dissolved Oxygen	EPA 360.2
108.590	001	Biochemical Oxygen Demand	SM5210B
Field of Testing: 113 - Whole Effluent Toxicity of Wastewater			
113.010	001A	Fathead Minnow (P. promelas)	EPA 600/4-90/027F, Static
113.010	001B	Fathead Minnow (P. promelas)	EPA 600/4-90/027F, Static Renewal
113.010	003A	Rainbow trout (O. mykiss)	EPA 600/4-90/027F, Static
113.010	003B	Rainbow trout (O. mykiss)	EPA 600/4-90/027F, Static Renewal
113.010	005A	Daphnid (C. dubia)	EPA 600/4-90/027F, Static
113.010	005B	Daphnid (C. dubia)	EPA 600/4-90/027F, Static Renewal
113.010	006A	Daphnia spp.	EPA 600/4-90/027F, Static
113.010	006B	Daphnia spp.	EPA 600/4-90/027F, Static Renewal
113.010	008A	Topsmelt (A. affinis)	EPA 600/4-90/027F, Static
113.010	008B	Topsmelt (A. affinis)	EPA 600/4-90/027F, Static Renewal
113.010	009A	Silverside (Menidia spp.)	EPA 600/4-90/027F, Static
113.010	009B	Silverside (Menidia spp.)	EPA 600/4-90/027F, Static Renewal
113.010	012A	Mysid (M. bahia)	EPA 600/4-90/027F, Static
113.010	012B	Mysid (M. bahia)	EPA 600/4-90/027F, Static Renewal
113.021	001A	Fathead Minnow (P. promelas)	EPA 2000 (EPA-821-R-02-012), Static
113.021	001B	Fathead Minnow (P. promelas)	EPA 2000 (EPA-821-R-02-012), Static Renewal
113.022	003A	Rainbow trout (O. mykiss)	EPA 2019 (EPA-821-R-02-012), Static
113.022	003B	Rainbow trout (O. mykiss)	EPA 2019 (EPA-821-R-02-012), Static Renewal
113.023	005A	Daphnid (C. dubia)	EPA 2002 (EPA-821-R-02-012), Static
113.023	005B	Daphnid (C. dubia)	EPA 2002 (EPA-821-R-02-012), Static Renewal
113.024	006A	Daphnia spp.	EPA 2021 (EPA-821-R-02-012), Static
113.024	006B	Daphnia spp.	EPA 2021 (EPA-821-R-02-012), Static Renewal
113.025	009A	Silverside (Menidia spp.)	EPA 2006 (EPA-821-R-02-012), Static
113.025	009B	Silverside (Menidia spp.)	EPA 2006 (EPA-821-R-02-012), Static Renewal
113.027	012A	Mysid (M. bahia)	EPA 2007 (EPA-821-R-02-012), Static
113.027	012B	Mysid (M. bahia)	EPA 2007 (EPA-821-R-02-012), Static Renewal

As of 12/04/2006 , this list supersedes all previous lists for this certificate number.
Customers: Please verify the current accreditation standing with the State.

113.028	008A	Topsmelt (A. affinis)	EPA-821-R-02-012, Static
113.028	008B	Topsmelt (A. affinis)	EPA-821-R-02-012, Static Renewal
113.040	001	Fathead Minnow (P. promelas)	EPA 1000 (EPA/600/4-91/002)
113.041	001	Fathead Minnow (P. promelas)	EPA 1000 (EPA-821-R-02-013)
113.050	005	Daphnid (C. dubia)	EPA 1002 (EPA/600/4-91/002)
113.051	005	Daphnid (C. dubia)	EPA 1002 (EPA-821-R-02-013)
113.060	020	Green algae (S. capricornutum)	EPA 1003 (EPA/600/4-91/002)
113.061	020	Green algae (S. capricornutum)	EPA 1003 (EPA-821-R-02-013)
113.080	009	Silverside (Menidia spp.)	EPA 1006 (EPA/600/4-91/003)
113.081	009	Silverside (Menidia spp.)	EPA 1006 (EPA-821-R-02-014)
113.090	012	Mysid (M. bahia)	EPA 1007 (EPA/600/4-91/003)
113.091	012	Mysid (M. bahia)	EPA 1007 (EPA-821-R-02-014)
113.120	008	Topsmelt (A. affinis)	EPA 600/R-95/136
113.120	017D	Purple sea urchin (S. purpuratus)	EPA 600/R-95/136, Fertilization Test
113.120	017E	Purple sea urchin (S. purpuratus)	EPA 600/R-95/136, Development Test
113.120	022	Giant kelp (M. pyrifera)	EPA 600/R-95/136
113.120	023	Red abalone (H. rufescens)	EPA 600/R-95/136
Field of Testing: 119 - Toxicity Bioassay of Hazardous Waste			
119.010	001	Fathead Minnow (P. promelas)	Polisini & Miller (CDFG 1988)
119.010	003	Rainbow trout (O. mykiss)	Polisini & Miller (CDFG 1988)
Field of Testing: 126 - Microbiology of Recreational Water			
126.010	001	Total Coliform (Enumeration)	SM9221A,B,C
126.030	001	Fecal Coliform (Enumeration)	SM9221E
126.050	001	Total Coliform and E. coli	SM9223
126.080	001	Enterococci	IDEXX

As of 12/04/2006, this list supersedes all previous lists for this certificate number.
Customers: Please verify the current accreditation standing with the State.

APPENDIX 8.5. MOST RECENT DMR & WP STUDY RESULTS

ENVIRONMENTAL
RESOURCE ASSOCIATES®
The Industry Standard™

Elizabeth Maturino
Aquatic Bioassay
29 N Olive St
Ventura, CA 93001

DMR-QA 28 Final Report

DMR-QA Proficiency Testing™

DMR-QA Study

Open Date: 05/01/08

Close Date: 08/29/08

Report Issued Date: 10/17/08

ENVIRONMENTAL
RESOURCE ASSOCIATES®
The Industry Standard™

Study: **DMR-QA 28**

ERA Customer Number: **A548301**

Laboratory Name: **Aquatic Bioassay**

WET Results

DMR-QA 28 Final Complete Report

ENVIRONMENTAL RESOURCE ASSOCIATES®
The Industry Standard™

Elizabeth Maturino
Aquatic Bioassay
29 N Olive St
Ventura, CA 93001
(805) 643-5621

EPA ID: CA00021
ERA Customer Number: A548301
Report Issued: 10/17/08
Study Dates: 05/01/08 - 08/29/08

Anal. No.	Test End Point	Reported Value %	Assigned Value %	Acceptance Limits %	Performance Evaluation	Method Description
DMRQA Fathead minnow (Test Code 13)						
48Hr., Acute, Non-Renewal, 25° C, MHSF						
Ammonium phosphate dibasic						
0754	LC50	38.6	28.0	11.5 - 44.4	Acceptable	EPA 2000
DMRQA Fathead minnow (Test Code 15)						
7-day Short term Chronic, Daily Renewal, MHSF						
Ammonium phosphate dibasic						
0808	IC25 (ON) Growth	51.63	31.1	15.9 - 46.2	Not Acceptable	EPA 1000
0809	IC25 (SN) Growth		38.5	9.67 - 67.3	Not Reported	
0810	NOEC (ON) Growth	50	25.0	12.5 - 50.0	Acceptable	EPA 1000
0811	NOEC (SN) Growth		25.0	12.5 - 50.0	Not Reported	
0756	NOEC Survival	50	25.0	12.5 - 50.0	Acceptable	EPA 1000
DMRQA Ceriodaphnia dubia (Test Code 19)						
48Hr., Acute Renewal, 25° C, MHSF						
Ammonium phosphate dibasic						
0764	LC50	> 100	53.7	11.7 - 95.7	Not Acceptable	EPA 2002
DMRQA Ceriodaphnia dubia (Test Code 21)						
7-day Short term Chronic, Daily Renewal, MHSF						
Potassium chloride						
0767	IC25 Reproduction	24.62	27.8	14.6 - 41.1	Acceptable	EPA 1002
0768	NOEC Reproduction	25	25.0	12.5 - 50.0	Acceptable	EPA 1002
0766	NOEC Survival	25	25.0	12.5 - 50.0	Acceptable	EPA 1002
DMRQA Daphnia magna (Test Code 32)						
48Hr., Acute, Non-Renewal, 20° C, MHSF						
Potassium chloride						
0788	LC50	75.8	64.4	51.0 - 77.8	Acceptable	EPA 2021
DMRQA Mysid (Test Code 42)						
48Hr., Acute, Non-Renewal, 20° C, 40 FSW						
Potassium chloride						
0798	LC50	48.3	38.4	14.8 - 61.9	Acceptable	EPA 2007
DMRQA Mysid (Test Code 43)						
7-day Short term Chronic, Daily Renewal, 40 FSW						
Potassium chloride						
0816	IC25 (ON) Growth	34.7	31.9	25.3 - 38.6	Acceptable	EPA 1007
0817	IC25 (SN) Growth		32.1	9.29 - 54.8	Not Reported	
0818	NOEC (ON) Growth	25	25.0	12.5 - 50.0	Acceptable	EPA 1007
0819	NOEC (SN) Growth		25.0	12.5 - 50.0	Not Reported	
0799	NOEC Survival	25	25.0	12.5 - 50.0	Acceptable	EPA 1007

All analytes are included in ERA's A2LA accreditation. Lab Code: 1539-01

DMR-QA 28 Final Complete Report

ENVIRONMENTAL RESOURCE ASSOCIATES®
The Industry Standard™

Elizabeth Maturino
Aquatic Bioassay
29 N Olive St
Ventura, CA 93001
(805) 643-5621

EPA ID: CA00021
ERA Customer Number: A548301
Report Issued: 10/17/08
Study Dates: 05/01/08 - 08/29/08

Anal. No.	Test End Point	Reported Value %	Assigned Value %	Acceptance Limits %	Performance Evaluation	Method Description
DMRQA Inland silverside (Test Code 44)						
48Hr., Acute, Non-Renewal, 20° C, 40 FSW						
Phenol						
0803	LC50	37.4	30.1	16.5 - 43.7	Acceptable	EPA 2006

All analytes are included in ERA's A2LA accreditation. Lab Code: 1539-01

AQUATIC
BIOASSAY &
CONSULTING
LABORATORIES, INC.

TOXICITY TESTING • OCEANOGRAPHIC RESEARCH

October 24, 2008

Dear Client:

In response to the "Not Acceptable" performance evaluation for EPA Method Test Code 15, *Fathead Minnow*, 7-day Short term chronic, Daily renewal, IC25 (ON) Growth and Method Test Code 19, Ceriodaphnia dubia, 48 Hr. Acute renewal, 25°, LC50 for the recent DMR-QA Study 28 we have determined the following.

The initial tests were conducted in duplicate. For test code 15, chronic fathead minnow test we had results of 55.2 and 48.1 for the IC25 growth. The averaged value of these two tests, 51.63 was reported. The test acceptance limits were 15.9-46.2. All other endpoints for this test were acceptable. We examined all test procedures with all analysts involved and determined there were no deviations from normal test procedures. Since our results for the other test endpoints were at the upper end of the acceptable range it is apparent that the fish used for this testing had uniformly more resistance to the ERA supplied unknown toxicant. We have used the same organism supplier for numerous years with success. Our internal reference toxicant tests are consistently acceptable. As populations of fathead minnows vary, the instance of having one test near, above or below, the test range is not abnormal. In addition, our reported value for the IC25 was only slightly higher than the upper end of the acceptance limit. Regardless, we immediately ordered backup check samples to further investigate this discrepancy.

With regard to 48 hr. acute LC50 results for test code 19, *Ceriodaphnia dubia*, Again this test was conduted in duplicate and both resulted in an LC50 >100. We examined all test procedures with all analysts involved and determined there were no deviations from normal test procedures. Since the upper range of the test acceptance limits were nearly 96% and as populations of *Ceriodaphnia dubia* vary, the instance of having one test near, above or below, the test range is not abnormal. Regardless, we immediately ordered backup check samples to further investigate this discrepancy.

The results of the back-up support testing will be supplied and discussed as soon as they are available.

The results of these tests reinforce the EPA guidance that multiple tests better define a waste.

Yours very truly,

Michael Machuzak
Laboratory Manager

29 NORTH OLIVE STREET, VENTURA, CA 93001 • (805) 643-5621

AQUATIC
BIOASSAY &
CONSULTING
LABORATORIES, INC.

TOXICITY TESTING • OCEANOGRAPHIC RESEARCH

November 13, 2008

Dear Client:

Enclosed you will find results from our backup check samples that we tested in relation to our DMR-QA Study 28 "Not Acceptable" results that were presented in our letter to you dated 24 October 2008.

Additional testing was conducted with fathead minnows, *Pimephales promelas*. We ordered a check sample from ERA and conducted a 7 day chronic toxicity test. The results of that test were in agreement with the ERA certified values. The certified survival NOEC endpoint was 25%. Our results were 25%. The certified growth NOEC was 25%. Our NOEC was 25% for the growth endpoint. The certified endpoint for the IC25 was 29.9% with an acceptance range of 22.0%-37.7%. Our result for this endpoint was 30.89%.

The check sample we tested with the water flea, *Ceriodaphnia dubia*, was also in agreement. The certified value for the 48 hour IC50 was 48.9% with an acceptance range of 20.0%-77.8%. Our result for this endpoint was 50.0%.

We found no other discrepancies with our routine test procedures.

The results of these tests reinforce the EPA guidance that multiple tests better define a waste.

Yours very truly,

Michael Machuzak
Laboratory Manager

29 NORTH OLIVE STREET, VENTURA, CA 93001 • (805) 643-5621

AQUATIC
BIOASSAY &
CONSULTING
LABORATORIES, INC.

TOXICITY TESTING • OCEANOGRAPHIC RESEARCH

CHRONIC FATHEAD MINNOW SURVIVAL AND GROWTH BIOASSAY

DATE: 28 October 2008

STANDARD TOXICANT: ERA QA LOT # Q027-004

ENDPOINT: SURVIVAL

NOEC = 25.00 %

IC25 = 30.29 %
IC50 = 37.50 %

ENDPOINT: GROWTH

NOEC = 25.00 %

IC25 = 30.89 %
IC50 = 37.98 %

Yours very truly,

Thomas (Tim) Mikel
Laboratory Director

29 NORTH OLIVE STREET, VENTURA, CA 93001 • (805) 643-5621

Larval Fish Growth and Survival Test-7 Day Survival

Start Date:	10/28/2008	Test ID:	DMRQA28	Sample ID:	CODE 15
End Date:	11/4/2008	Lab ID:	CAABC	Sample Type:	ERA QC Lot# Q027-004
Sample Date:	10/28/2008	Protocol:	EPA-821-R-02-013	Test Species:	PP-Pimephales promelas
Comments:	DMRQA 28 Code 15 Tox Standard Check Sample				

Conc-%	1	2	3	4
N Control	1.0000	1.0000	1.0000	1.0000
6.25	1.0000	1.0000	1.0000	1.0000
12.5	1.0000	1.0000	1.0000	0.9333
25	1.0000	0.8667	0.9333	0.9333
50	0.0667	0.2000	0.0000	0.0000
100	0.0000	0.0000	0.0000	0.0000

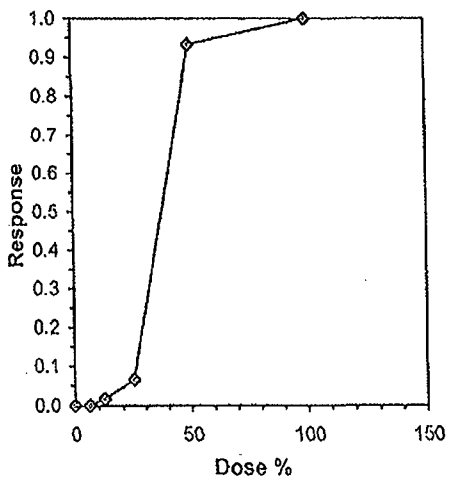
			Transform: Arcsin Square Root					Rank	1-Tailed	Isotonic	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical	Mean	N-Mean
N Control	1.0000	1.0000	1.4413	1.4413	1.4413	0.000	4			1.0000	1.0000
6.25	1.0000	1.0000	1.4413	1.4413	1.4413	0.000	4	18.00	10.00	1.0000	1.0000
12.5	0.9833	0.9833	1.4084	1.3096	1.4413	4.675	4	16.00	10.00	0.9833	0.9833
25	0.9333	0.9333	1.3144	1.1970	1.4413	7.600	4	12.00	10.00	0.9333	0.9333
*50	0.0667	0.0667	0.2459	0.1295	0.4636	64.190	4	10.00	10.00	0.0667	0.0667
*100	0.0000	0.0000	0.1295	0.1295	0.1295	0.000	4	10.00	10.00	0.0000	0.0000

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.7759	0.884	0.87231	3.38396
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	25	50	35.3553	4
Treatments vs N Control				

Linear Interpolation (200 Resamples)

Point	%	SD	95% CL(Exp)		Skew
IC05	20.833	3.502	11.400	28.929	-0.4488
IC10	25.962	0.866	21.554	27.996	-2.0444
IC15	27.404	0.625	25.374	29.391	-0.1322
IC20	28.846	0.601	27.216	30.859	-0.0173
IC25	30.288	0.589	28.619	32.439	0.1136
IC40	34.615	0.627	33.049	36.930	0.4945
IC50	37.500	0.706	35.895	40.115	0.6530

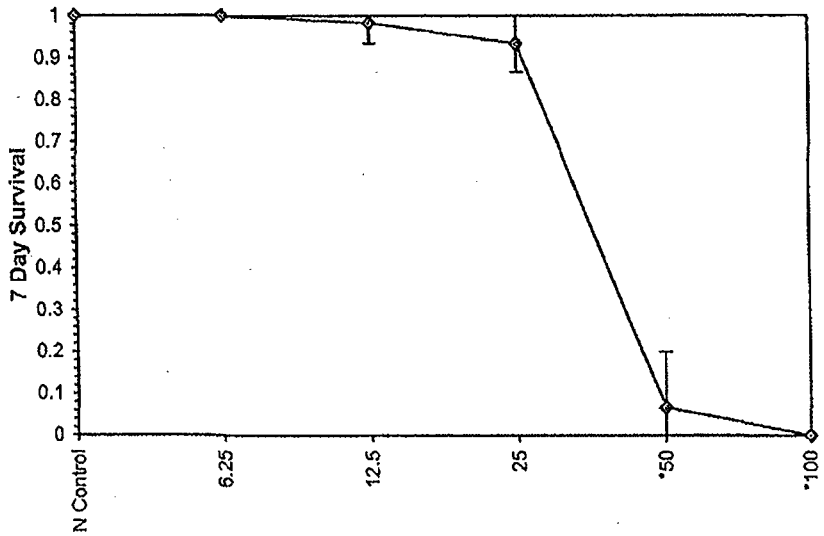


Reviewed by:

Larval Fish Growth and Survival Test-7 Day Survival

Start Date:	10/28/2008	Test ID:	DMRQA28	Sample ID:	CODE 15
End Date:	11/4/2008	Lab ID:	CAABC	Sample Type:	ERA QC Lot# Q027-004
Sample Date:	10/28/2008	Protocol:	EPA-821-R-02-013	Test Species:	PP-Pimephales promelas
Comments:	DMRQA 28 Code 15 Tox Standard Check Sample				

Dose-Response Plot



ToxCalc v5.0.23

Reviewed by:

Larval Fish Growth and Survival Test-7 Day Biomass

Start Date:	10/28/2008	Test ID:	DMRQA28	Sample ID:	CODE 15
End Date:	11/4/2008	Lab ID:	CAABC	Sample Type:	ERA QA Lot#Q027-004
Sample Date:	10/28/2008	Protocol:	EPA-821-R-02-013	Test Species:	PP-Pimephales promelas
Comments:	DMRQA 28 Code 15 Tox Standard Check Sample				

Conc-%	1	2	3	4
N Control	0.2880	0.3113	0.3280	0.3447
6.25	0.3180	0.3173	0.3093	0.3240
12.5	0.3453	0.3293	0.3400	0.3200
25	0.3093	0.2880	0.3320	0.3080
50	0.0240	0.0740	0.0000	0.0000
100	0.0000	0.0000	0.0000	0.0000

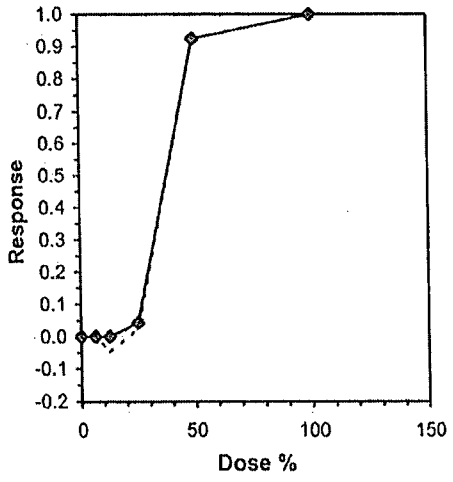
			Transform: Untransformed					Rank	1-Tailed	Isotonic	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical	Mean	N-Mean
N Control	0.3180	1.0000	0.3180	0.2880	0.3447	7.607	4			0.3229	1.0000
6.25	0.3172	0.9974	0.3172	0.3093	0.3240	1.899	4	17.00	10.00	0.3229	1.0000
12.5	0.3337	1.0493	0.3337	0.3200	0.3453	3.381	4	22.00	10.00	0.3229	1.0000
25	0.3093	0.9727	0.3093	0.2880	0.3320	5.815	4	15.50	10.00	0.3093	0.9579
*50	0.0245	0.0770	0.0245	0.0000	0.0740	142.390	4	10.00	10.00	0.0245	0.0759
*100	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	4	10.00	10.00	0.0000	0.0000

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates normal distribution (p > 0.01)	0.91947	0.884	0.78616	2.00137
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test Treatments vs N Control	25	50	35.3553	4

Linear Interpolation (200 Resamples)

Point	%	SD	95% CL(Exp)		Skew
IC05	25.223	2.989	10.759	27.035	-2.1979
IC10	26.640	1.020	23.763	28.353	-3.1093
IC15	28.057	0.731	25.696	29.778	-0.5137
IC20	29.474	0.719	27.190	31.398	-0.3419
IC25	30.892	0.721	28.588	33.090	-0.1339
IC40	35.143	0.805	32.822	38.369	0.4582
IC50	37.978	0.913	35.569	41.764	0.6812

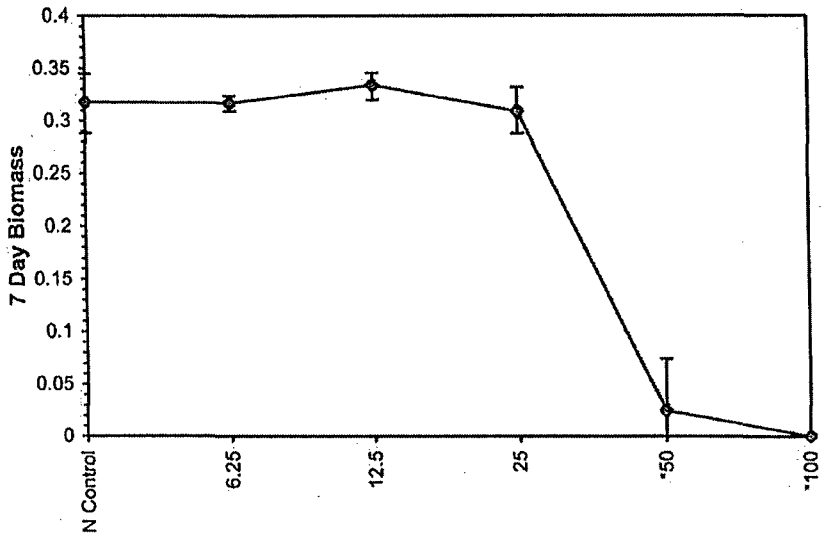


Reviewed by:

Larval Fish Growth and Survival Test-7 Day Biomass

Start Date:	10/28/2008	Test ID:	DMRQA28	Sample ID:	CODE 15
End Date:	11/4/2008	Lab ID:	CAABC	Sample Type:	ERA QA Lot#Q027-004
Sample Date:	10/28/2008	Protocol:	EPA-821-R-02-013	Test Species:	PP-Pimephales promelas
Comments:	DMRQA 28 Code 15 Tox Standard Check Sample				

Dose-Response Plot



Reviewed by:

Larval Fish Growth and Survival Test-7 Day Biomass

Start Date:	10/28/2008	Test ID:	DMRQA28	Sample ID:	CODE 15
End Date:	11/4/2008	Lab ID:	CAABC	Sample Type:	ERA QA Lot#Q027-004
Sample Date:	10/28/2008	Protocol:	EPA-821-R-02-013	Test Species:	PP-Pimephales promelas
Comments:	DMRQA 28 Code 15 Tox Standard Check Sample				

Auxiliary Data Summary

Conc-%	Parameter	Mean	Min	Max	SD	CV%	N
N Control	Temp C	24.68	24.00	25.50	0.61	3.16	8
6.25		24.68	24.00	25.50	0.61	3.16	8
12.5		24.68	24.00	25.50	0.61	3.16	8
25		24.68	24.00	25.50	0.61	3.16	8
50		24.68	24.00	25.50	0.61	3.16	8
100		24.35	24.00	24.70	0.49	2.89	2
N Control	pH	7.90	7.90	7.90	0.00	0.00	8
6.25		7.65	7.50	7.80	0.11	4.27	8
12.5		7.59	7.40	7.70	0.10	4.15	8
25		7.58	7.40	7.70	0.10	4.25	8
50		7.59	7.50	7.70	0.08	3.81	8
100		7.65	7.60	7.70	0.07	3.48	2
N Control	DO mg/L	7.36	6.70	8.10	0.53	9.85	8
6.25		7.11	6.50	7.90	0.52	10.19	8
12.5		7.14	6.30	8.00	0.58	10.70	8
25		7.16	6.40	7.90	0.52	10.05	8
50		7.14	6.50	7.90	0.52	10.06	8
100		7.30	6.80	7.80	0.71	11.52	2
N Control	Hardness mg/L	83.13	80.00	86.00	2.64	1.96	8
6.25		0.00	0.00	0.00	0.00		0
12.5		0.00	0.00	0.00	0.00		0
25		0.00	0.00	0.00	0.00		0
50		0.00	0.00	0.00	0.00		0
100		81.00	81.00	81.00	0.00	0.00	2
N Control	Cond-umhos	355.00	327.00	377.00	20.85	1.29	8
6.25		578.63	515.00	607.00	29.69	0.94	8
12.5		828.38	802.00	859.00	19.60	0.53	8
25		1326.50	1299.00	1380.00	24.91	0.38	8
50		2273.50	2193.00	2357.00	54.99	0.33	8
100		4181.00	4181.00	4181.00	0.00	0.00	2
N Control	Alkalinity mg/L	60.00	60.00	60.00	0.00	0.00	8
6.25		0.00	0.00	0.00	0.00		0
12.5		0.00	0.00	0.00	0.00		0
25		0.00	0.00	0.00	0.00		0
50		0.00	0.00	0.00	0.00		0
100		58.00	58.00	58.00	0.00	0.00	2

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Lot No. Q027-004
USEPA Test Code 15, USEPA Method Code 1000.0
Fathead Minnow
7-day, Short Term Chronic, Daily Renewal, 25°C
Moderately Hard Synthetic Freshwater (MHSF)
Reference Toxicant - Potassium Chloride - KCl

Whole Effluent Toxicity QC Standards

Catalog No AQC004

Test Endpoint	Certified Value [1] %	QC PALs ™ [2] %	PT PALs ™ [3] %
IC25 (ON) Growth	29.9	22.0 - 37.7	22.0 - 37.7
IC25 (SN) Growth	41.7	5.35 - 78.0	5.35 - 78.0
NOEC (ON) Growth	25.0	12.5 - 50.0	12.5 - 50.0
NOEC (SN) Growth	25.0	12.5 - 50.0	12.5 - 50.0
NOEC Survival	25.0	12.5 - 50.0	12.5 - 50.0

Dilution:

Test Endpoint	Round Robin Data Mean %	Acceptable n	Total n	Toxicant Concentration
IC25 (ON) Growth	29.9	48	56	2.00 g/L
IC25 (SN) Growth	41.7	28	29	2.00 g/L
NOEC (ON) Growth	25.0	54	55	2.00 g/L
NOEC (SN) Growth	25.0	30	30	2.00 g/L
NOEC Survival	25.0	59	59	2.00 g/L

Please see footnotes on back

AQUATIC
BIOASSAY &
CONSULTING
LABORATORIES, INC.

TOXICITY TESTING • OCEANOGRAPHIC RESEARCH

48 HOUR ACUTE CERIODAPHNIA SURVIVAL

DATE: 28 October - 08

STANDARD TOXICANT: ERA QC LOT#Q027-008

ENDPOINT: SURVIVAL

NOEC = 50.00 %

IC25 = 37.50 %
IC50 = 50.00 %

Yours very truly,

Thomas (Tim) Mikel
Laboratory Director

29 NORTH OLIVE STREET, VENTURA, CA 93001 • (805) 643-5621

-48 Hr Survival

Start Date:	10/28/2008	Test ID:	DMRQA 28	Sample ID:	CA0000000
End Date:	10/30/2008	Lab ID:	CAABC	Sample Type:	ERA QC Lot#Q027-008
Sample Date:	10/28/2008	Protocol:	EPA-821-R-02-012	Test Species:	CD-Ceriodaphnia dubia
Comments:	DMR QA 28 Code 19 Tox Standard Check Sample				

Conc-%	1	2	3	4
N Control	1.0000	1.0000	1.0000	1.0000
6.25	1.0000	1.0000	1.0000	1.0000
12.5	1.0000	1.0000	1.0000	1.0000
25	1.0000	1.0000	1.0000	1.0000
50	0.4000	0.4000	1.0000	0.2000
100	0.0000	0.2000	0.0000	0.0000

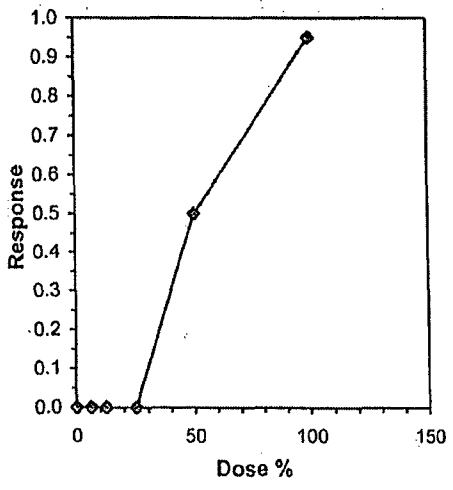
			Transform: Arcsin Square Root					Rank	1-Tailed	Isotonic	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	Sum	Critical	Mean	N-Mean
N Control	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4			1.0000	1.0000
6.25	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	10.00	1.0000	1.0000
12.5	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	10.00	1.0000	1.0000
25	1.0000	1.0000	1.3453	1.3453	1.3453	0.000	4	18.00	10.00	1.0000	1.0000
50	0.5000	0.5000	0.7946	0.4636	1.3453	48.029	4	12.00	10.00	0.5000	0.5000
*100	0.0500	0.0500	0.2850	0.2255	0.4636	41.771	4	10.00	10.00	0.0500	0.0500

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.62195	0.884	2.09856	10.2485
Equality of variance cannot be confirmed				

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU
Steel's Many-One Rank Test	50	100	70.7107	2
Treatments vs N Control				

Linear Interpolation (200 Resamples)

Point	%	SD	95% CL(Exp)		Skew
IC05	27.500	2.186	26.352	36.833	7.8687
IC10	30.000	3.134	27.705	48.667	3.9785
IC15	32.500	4.272	29.057	60.500	3.0311
IC20	35.000	4.785	30.410	64.000	2.3994
IC25	37.500	5.314	31.762	67.500	1.9372
IC40	45.000	7.043	35.819	78.000	1.1956
IC50	50.000	8.451	38.524	85.000	0.8440

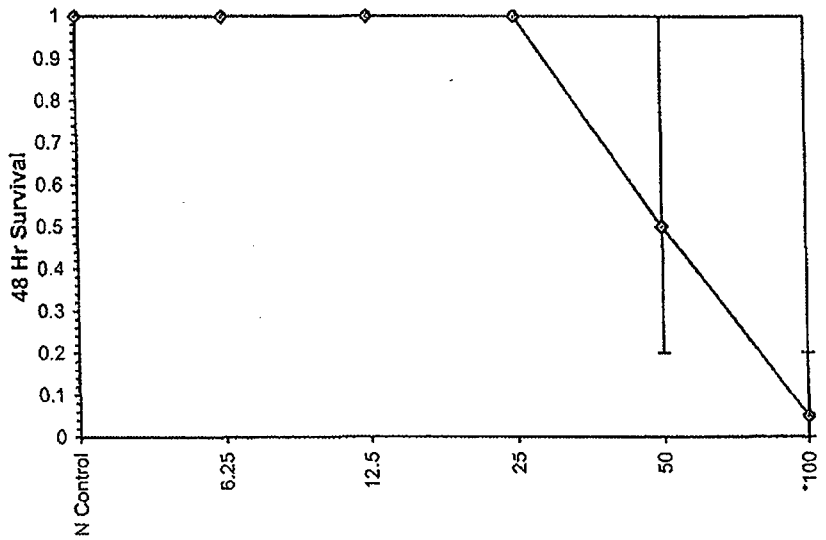


Reviewed by:

-48 Hr Survival

Start Date:	10/28/2008	Test ID:	DMRQA 28	Sample ID:	CA0000000
End Date:	10/30/2008	Lab ID:	CAABC	Sample Type:	ERA QC Lot#Q027-008
Sample Date:	10/28/2008	Protocol:	EPA-821-R-02-012	Test Species:	CD-Ceriodaphnia dubia
Comments:	DMR QA 28 Code 19 Tox Standard Check Sample				

Dose-Response Plot



Reviewed by:

-48 Hr Survival

Start Date:	10/28/2008	Test ID:	DMRQA 28	Sample ID:	CA0000000
End Date:	10/30/2008	Lab ID:	CAABC	Sample Type:	ERA QC Lot#Q027-008
Sample Date:	10/28/2008	Protocol:	EPA-821-R-02-012	Test Species:	CD-Ceriodaphnia dubia
Comments:	DMR QA 28 Code 19 Tox Standard Check Sample				

Auxiliary Data Summary

Conc-%	Parameter	Mean	Min	Max	SD	CV%	N
N Control	Temp C	24.23	24.00	24.70	0.40	2.62	3
6.25		24.23	24.00	24.70	0.40	2.62	3
12.5		24.23	24.00	24.70	0.40	2.62	3
25		24.23	24.00	24.70	0.40	2.62	3
50		24.23	24.00	24.70	0.40	2.62	3
100		24.23	24.00	24.70	0.40	2.62	3
N Control	pH	7.87	7.80	7.90	0.06	3.05	3
6.25		7.50	7.40	7.60	0.10	4.22	3
12.5		7.47	7.40	7.50	0.06	3.22	3
25		7.47	7.40	7.50	0.06	3.22	3
50		7.47	7.40	7.50	0.06	3.22	3
100		7.53	7.50	7.60	0.06	3.19	3
N Control	DO mg/L	7.30	6.90	7.90	0.53	9.96	3
6.25		7.33	6.80	7.60	0.46	9.27	3
12.5		7.40	6.90	7.70	0.44	8.92	3
25		7.43	6.90	7.80	0.47	9.25	3
50		7.50	7.00	7.90	0.46	9.03	3
100		7.50	7.10	7.90	0.40	8.43	3
N Control	Hardness mg/L	84.33	81.00	86.00	2.89	2.01	3
6.25		0.00	0.00	0.00	0.00		0
12.5		0.00	0.00	0.00	0.00		0
25		0.00	0.00	0.00	0.00		0
50		0.00	0.00	0.00	0.00		0
100		73.33	73.00	74.00	0.58	1.04	3
N Control	Cond umhos	355.00	347.00	364.00	8.54	0.82	3
6.25		466.00	455.00	474.00	9.85	0.67	3
12.5		580.67	563.00	592.00	15.50	0.68	3
25		833.00	831.00	835.00	2.00	0.17	3
50		1317.67	1288.00	1333.00	25.70	0.38	3
100		2115.67	1801.00	2323.00	277.06	0.79	3
N Control	Alkalinity mg/L	60.00	60.00	60.00	0.00	0.00	3
6.25		0.00	0.00	0.00	0.00		0
12.5		0.00	0.00	0.00	0.00		0
25		0.00	0.00	0.00	0.00		0
50		0.00	0.00	0.00	0.00		0
100		55.00	55.00	55.00	0.00	0.00	3

ENVIRONMENTAL
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DataPacK™

Lot No. Q027-008
USEPA Test Code 19, USEPA Method Code 2002.0
Ceriodaphnia dubia
48-hour, Acute, Daily Renewal, 25 °C
Moderately Hard Synthetic Freshwater (MHSF)
Reference Toxicant - Potassium Chloride - KCl

Whole Effluent Toxicity QC Standards

Catalog No AQC008

Test Endpoint	Certified Value [1] %	QC PALs ™ [2] %	PT PALs ™ [3] %
LC50	48.9	20.0 - 77.8	20.0 - 77.8

Test Endpoint	Round Robin Data Mean %	Acceptable n	Total n	Toxicant Concentration
LC50	48.8	54	55	1.00 g/L

Please see footnotes on back

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Elizabeth Maturino
Aquatic Bioassay
29 N Olive St
Ventura, CA 93001

WP-162 Final Report

WatR™ Pollution Proficiency Testing

WatR™ Pollution Study

Open Date: 07/14/08

Close Date: 08/28/08

Report Issued Date: 09/16/08

ENVIRONMENTAL
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The Industry Standard™

Study: **WP-162**

ERA Customer Number: **A548301**

Laboratory Name: **Aquatic Bioassay**

Microbiology Results

ENVIRONMENTAL RESOURCE ASSOCIATES®
The Industry Standard™

WP-162 Final Complete Report

Elizabeth Maturino
Aquatic Bioassay
29 N Olive St
Ventura, CA 93001
(805) 643-5621

EPA ID: CA00021
ERA Customer Number: A548301
Report Issued: 09/16/08
Study Dates: 07/14/08 - 08/28/08

Anal. No.	Analyte	Units	Reported Value	Assigned Value	Acceptance Limits	Performance Evaluation	Method Description
WP WP Coliform MicrobE™							
2500	Total Coliforms (MF)	CFU/100mL		77.0	35.0 - 172	Not Reported	
2530	Fecal Coliforms - E.coli (MF)	CFU/100mL		45.0	9.00 - 228	Not Reported	
2500	Total Coliforms (MPN)	MPN/100mL	72.8	71.0	15.4 - 328	Acceptable	SM9223 COLert18
2530	Fecal Coliforms - E.coli (MPN)	MPN/100mL	72.8	75.6	17.4 - 329	Acceptable	SM9223 COLert18
WP WP Coliform MicrobE™							
2500	Total Coliforms (MF)	CFU/100mL		77.0	35.0 - 172	Not Reported	
2530	Fecal Coliforms - E.coli (MF)	CFU/100mL		45.0	9.00 - 228	Not Reported	
2500	Total Coliforms (MPN)	MPN/100mL	50	71.0	15.4 - 328	Acceptable	SM9221B LTB
2530	Fecal Coliforms - E.coli (MPN)	MPN/100mL	50	75.6	17.4 - 329	Acceptable	SM9221B LTB
WP Enterococci							
2520	Enterococci (MF)	CFU/100mL		594	345 - 1020	Not Reported	
2520	Enterococci (MPN)	MPN/100mL	387.3	472	142 - 1570	Acceptable	ENTEROLERT
2540	Fecal Streptococci (MF)	CFU/100mL		604	413 - 882	Not Reported	
2540	Fecal Streptococci (MPN)	MPN/100mL		551	123 - 2460	Not Reported	
WP Enterococci							
2520	Enterococci (MF)	CFU/100mL		594	345 - 1020	Not Reported	
2520	Enterococci (MPN)	MPN/100mL	900	472	142 - 1570	Acceptable	SM9230B MPN
2540	Fecal Streptococci (MF)	CFU/100mL		604	413 - 882	Not Reported	
2540	Fecal Streptococci (MPN)	MPN/100mL		551	123 - 2460	Not Reported	

All analytes are included in ERA's A2LA accreditation. Lab Code: 1539-01